

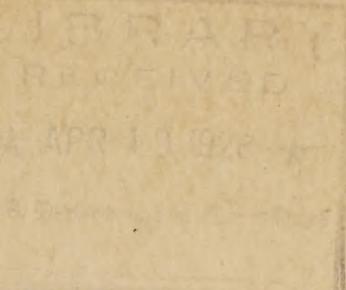
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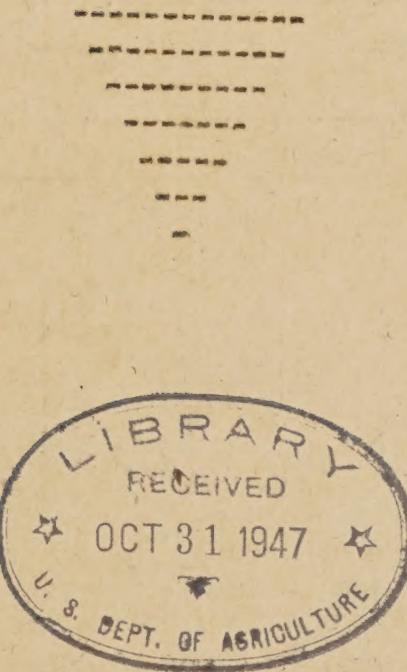
P R O G R A M - A N D - P L A N

O F

E U R O P E A N C O R N - B O R E R

I N V E S T I G A T I O N S

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Date	By whom reclassified	I	II	III	IV	V	Ayes	Noes	Signature of official
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RECLASSIFICATION

1. Questionnaire mailed -----
2. Questionnaire returned -----
3. Time extended to -----
4. Classification posted -----
5. Record forwarded to District Board -----
6. Record returned by District Board and classification posted -----
7. Record forwarded to President -----
8. Ordered to report for physical examination -----
9. Report of local examining physician -----
10. Report of medical advisory board -----
11. Action of Local Board on physical examination -----
12. Physical examination forwarded to District Board on appeal -----
13. Action of District Board on appeal -----
14. Physical examination record returned by District Board -----
15. Date ordered to report for entrance examination -----
16. Reported for entrance -----
17. Date of entrance -----
18. Rejected at mobilization camp -----
19. Reported to Adjutant General of Army -----
20. Transferred to Local Board for deserter -----
21. Date of apprehension -----
22. Date received at mobilization camp as delinquent -----

Qualified, Group A.	Qualified, Group B.	Qualified, Group C.	Qualified, Group D.
Constitutionally qualified.	Constitutionally qualified.	Constitutionally qualified.	Constitutionally qualified.

Qualified, Group A.	Qualified, Group B.	Qualified, Group C.	Qualified, Group D.
Constitutionally qualified.	Constitutionally qualified.	Constitutionally qualified.	Constitutionally qualified.

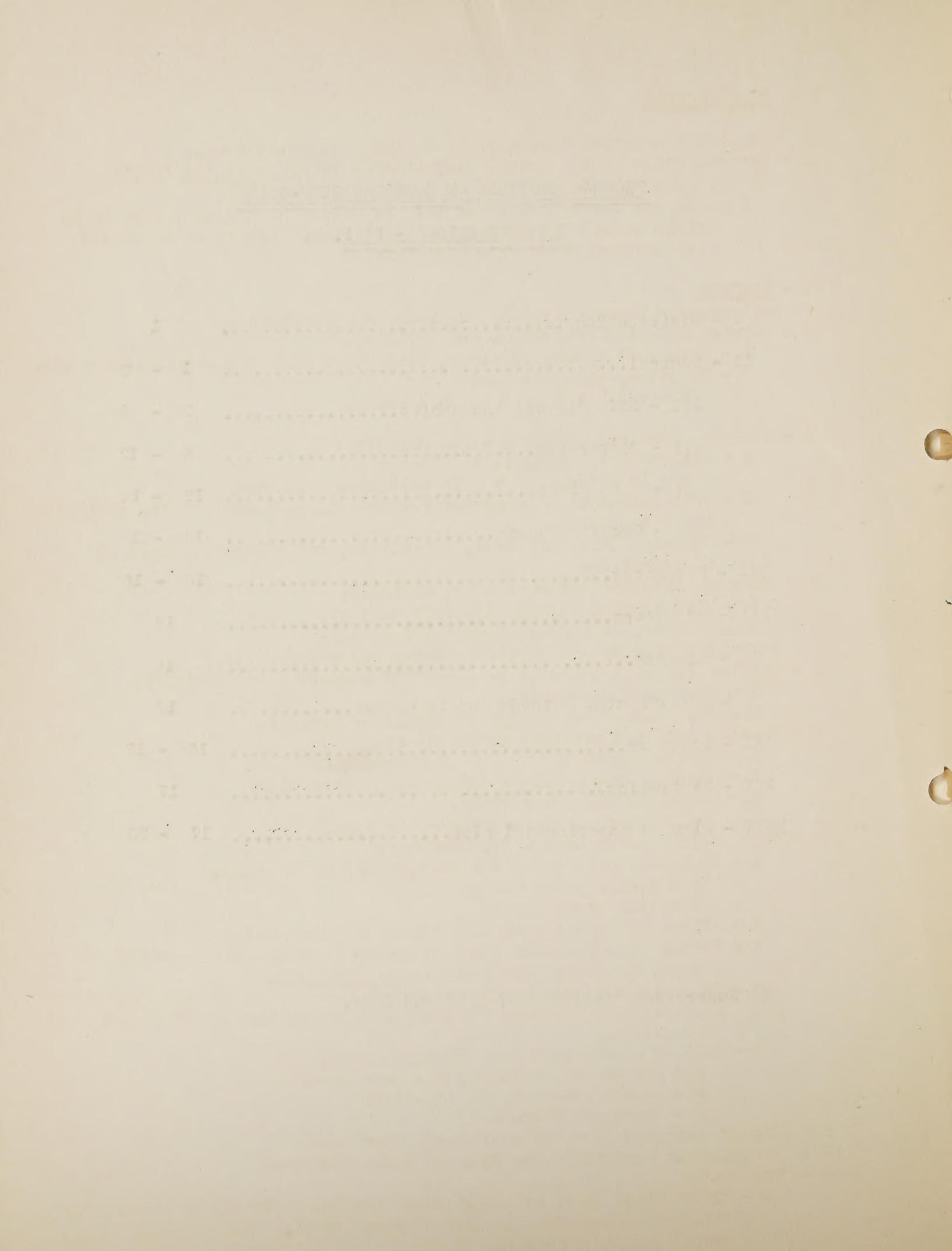
Name	Name of Registrant: Telephone No. -----				
	Order No.	Address	(City or town.) (No.) (Street or R. F. D. number.)	(County.) (State.) (Last name.)	
(Designation of District Board)					
Classification claimed by another person -----					
Classification claimed by an other person -----					
Vote of board on most detailed classification found -----					
Classification by Local or District Board -----					
Classification claimed by an other person -----					
(Designation of District Board)					
Stamp of Local Board					
Classification claimed by registrant -----					
(Last name.) (Middle name.) (First name.) (City or town.) (No.) (Street or R. F. D. number.)					
UNDER JURISDICTION OF LOCAL BOARD UNDER JURISDICTION OF DISTRICT BOARD					
Enter letters showing divisions claimed or found in squares showing classification found.)					
I II III IV V I II III IV V I II III IV V I II III IV V					
Ayes ----- Noes ----- Ayes ----- Noes -----					
Classification on appeal -----					
Report of board on most detailed classification found -----					
Action of District Board on appeal -----					
Report of medical advisory board -----					
Report of Local Board on appeal -----					
Signature of official					

PROGRAM AND PLAN OF EUROPEAN CORN-BORER

INVESTIGATIONS - 1921. #

	Pages
I - Distribution	1
II - Control.....	1 - 2
III - Life History and Habits.....	2 - 8
IV - Dispersion.....	8 - 12
V - Food Plants.....	12 - 14
VI - Genus Pyrausta.....	14 - 15
VII - Parasites.....	15 - 16
VIII - Predators.....	16
IX - Disease.....	16
X - Experimental Methods and Technique.....	16
XI - Taxonomy.....	16 - 17
XII - Statistics.....	17
XIII - Plan of Experimental Plot.....	17 - 20

Supersedes "Outline" of 1919 and 1920.



I DISTRIBUTION

Assignment:- Messrs Worthley, W. O. Ellis and assistants.

A - Determination of the actual distribution of P. nubilalis in the U. S., along the lines followed during 1919 and 1920.

1 - One man located at laboratory to determine material sent in by field scouts and quarantine inspectors. Adults to be reared for determination when necessary.

II - CONTROL.

Assignment:- Messrs Worthley, Caffrey and assistants.

A - Burning infested material - Mr. Worthley.

1 - Using oil torch, or flame, with power pump and specialized nozzle.
2 - In piles, using as fuel:
 a - Oil. b - Wood - c - Brush.

B - Steaming infested material - Mr. Worthley.

1 - With portable boiler.
 a - In piles. b - In collecting vehicle.

2 - With combination apparatus for steaming material in the collecting vehicle.

3 - Steaming loose material, or stubble, with a portable hood or modification.

C - Crushing infested material - Mr. Worthley.

1 - With special machine for this purpose.

D - Plowing under, or burying infested material.

(See "Life History and Habits" - B-2-d and D-2-e-(2)....)

E - Burying infested material in manure or compost - Mr. Worthley.

1 - When used as bedding.

2 - When buried originally in manure or compost.

F - Feeding infested material to livestock.

1 - Placing in silo. 2. Shredding.

3 - Cutting with ensilage cutter or modification.

4 - Direct feeding from field.

5 - Suitability of steamed fodder as food.

G - Weed killing substances - Mr. Worthley.

1 - Application to determine killing effect on weeds.

 a - Partly grown weeds.

 b - Full grown weeds.

2 - Effect on larvae contained within treated weeds.

3 - Effect on subsequent flora of treated areas, with especial reference to plants not hosts of P. nubilalis.

4 - Trap weeds - Leave small untreated areas of weeds as a trap for oviposition of moths. Trap weeds to be destroyed after period of oviposition.

5 - Cost of applications to definite areas.

 a - Patent preparations, b - Iron sulphate.

 c - Sodium arsenite d - Salt

 e - Other substances.

H - Time of planting (See "Plan of Expt. Plot" ---)

I - Selection of varieties (See "Plan of Expt. Plot" ---)

J - Trap Crops

1 - Plant small areas of early sweet corn in badly infested areas to attract ovipositing females of first brood. Such areas to be subsequently destroyed.

- 2 - Same for second brood-using quickly maturing varieties.
 3 - Effect on infestation, of plants other than corn, in the same, or adjoining, areas to where trap crops are used.
- K - Cutting corn stalks, or stubble, level with soil and immediately disposing of by feeding, crushing or otherwise.
- 1 - In a cleanly cultivated field.
 - a - As soon as crop is harvested.
 - b - Before beginning of winter.
 - c - Early in the Spring.
 - 2 - In a weedy field. a-b and c same as K-1.
- L - Application of poison sprays or dusts - Mr Worthley.
- 1 - Arsenate of lead. 2 - Calcium arsenate.
 - 3 - Magnesium arsenate. 4 - Other insecticides.
- M - Hogs.
- 1 - Turn hogs into badly infested corn, or weeds, after corn has been harvested to determine whether they will break open plants and devour *P. nubilalis* larvae or pupae. Possibly portions of infested plants may be eaten entire.

III - LIFE HISTORY AND HABITS.

Assignment:- Messrs Barber, Babcock, Hofer, Patch and assistants.

A - Egg.

- 1 - Description.
 - a - Immediately after deposition.
 - b - Changes of color, markings or shape during incubation.
- 2 - Incubation period.
 - a - Duration.
- 3 - Hatching.
 - a - Details of hatching.
 - b - Proportion of eggs hatching (Distinct from A-5-a)
 - (1) - In the field (2) - In laboratory or cages.
- 4 - Proportion of eggs dislodged from original position on plant, and the effect on hatching.
- 5 - Fertility.
 - a - Proportion of fertile eggs. (1) in the field. (2) In laboratory or cages.
 - b - Effect of sunlight on fertility (eggs habitually deposited on under side of leaf).
 - c - Effect of hillling-up on fertility of eggs deposited on lower part of plant.
 - d - Duration in cold storage.
- 6 - Reaction to water (See Dispersion - D-4-a- (1),..)

B - Larva.

1 - Life History.

- a - Description of each instar.
- b - Duration.
 - (1) Possible relation of sex to duration of instars.
 - (2) Total days for larval development.
- c - Molting.
 - (1) - Details of molting.
 - (2) - Location or position of larva when molting.
 - (3) - Duration of quiescent period before each molt.
 - (4) - " " period required for molting.
- d - Number of instars.
 - (1) - Relation of number of instars to sex.
 - (2) - " " " " food.

for our salvation.

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Geological Map of India

e - Prepupal period.

(1) - Details of cocoon formation.

(2) - Duration

(a) - Male. (b) - Female.

f - Habits.

a - Feeding habits in each instar.

(1) - Method of feeding.

(2) - Relative amount of food consumed in each instar.

(3) - Daily period of maximum feeding and activity.

b - Duration of life without food.

(1) - In each instar. (a) ability of first instar to molt without feeding.

Object: - To determine ability of larvae to maintain life if suitable food is not immediately available.

c - Adaptability to unusual hosts.

(1) - Development in material not ordinarily used as food.

(a) - Old corn-stalks (b) - Corn cobs.

(c) - Cork (d) - Other similar material.

Object: - To determine ability of insect to survive and multiply under adverse conditions.

d - Ability of larvae to reach surface of soil after burial of host, as in plowing under infested material.

Note: - Distinct from D-2-e "Ability of adults etc". Cross ref. to "Control - Plowing"

(1) - Buried at depths ranging from 2 to 18 inches.

Field and insectary investigations.

(a) - During late Summer or Autumn.

(b) - " the Spring.

e - Migration.

(1) - To other parts of same host. (2) - To other hosts.

(3) - Distance capable of migration in each instar.

(4) - Influence of weather on migration (wind, rain, etc)

(5) - Efficiency of natural or artificial barriers in limiting migration. i. e. - brooks, marshes, roads, walls, etc.

Note: - In instances where fields of celery etc are separated from badly infested corn, or weeds, by a natural barrier.

(6) - Possible migration of larvae in the Spring from winter host, or shelter plant, to green and growing plants, i. e. Rhubarb, spinach.

(7) - Daily and seasonal period of greatest activity in migration.

f - Hibernation.

(1) - Location in plant or other material.

(2) - Mortality.

(a) - Relation of mortality to condition, position or species of host plants.

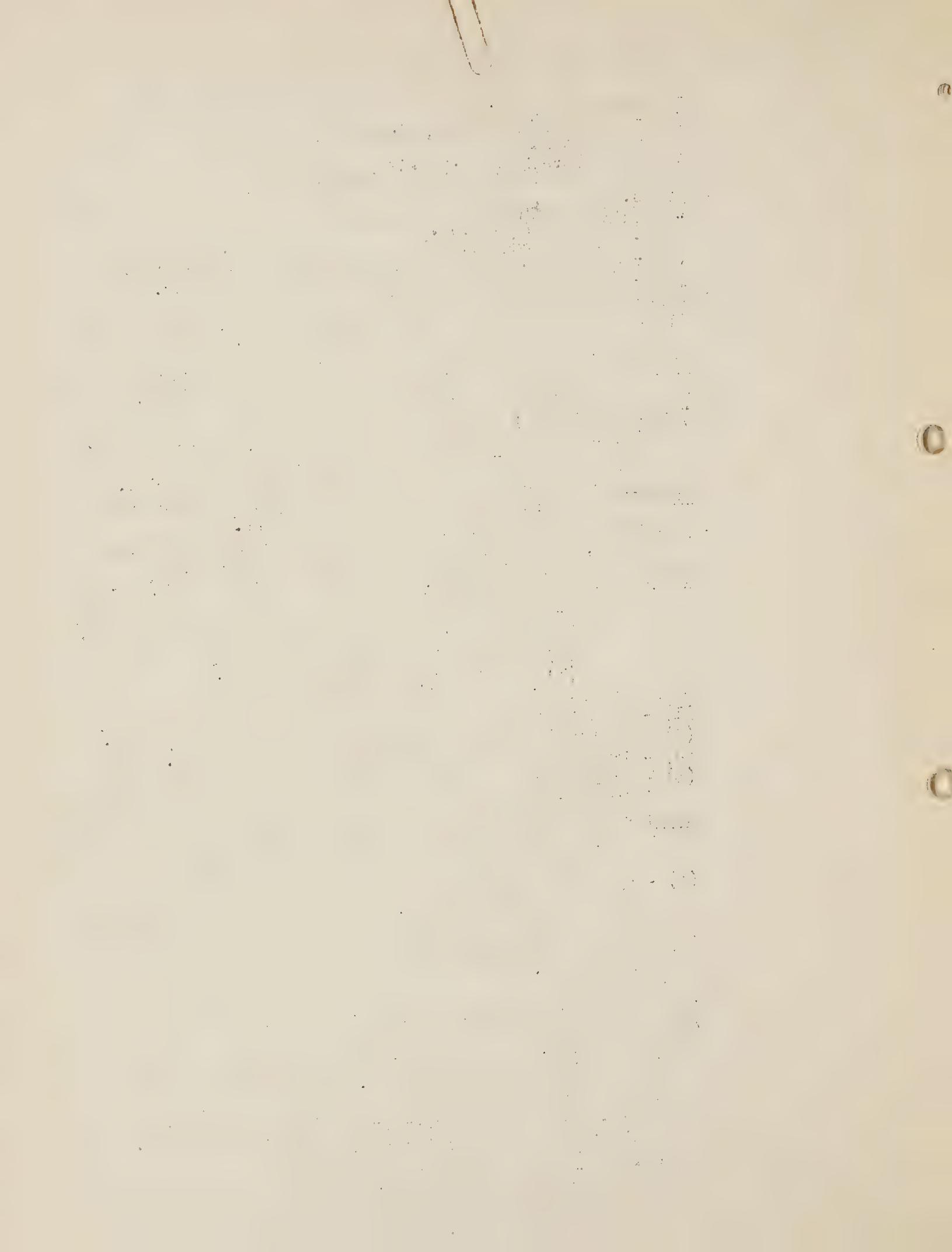
(aa) - Host plants standing in natural position.

(bb) - " " broken over and lying on ground.

(cc) - At varying heights above ground.

(dd) - " " depths below " .

Note: - Distinct from B-2-d. Infested plant material will be dug up and examined at frequent intervals during the Autumn, Winter and Spring.



(cc) - In protected locations (in buildings etc) (4)
(ff) - In other locations.

(aaa) - In empty boxes.

(bbb) - In protecting material i. e. moss, sawdust, dried leaves, wood humus, etc

(ccc) - In tree stumps, poles etc.

(ddd) - In silos, corn cribs etc.

(b) - Relative mortality during hibernation in different species of plants cut and piled.

(aa) - Corn stalks.

(bb) - Corn stubble pulled and left on surface of soil.

(cc) - Weeds (Barnyard grass, ragweed etc.)

(dd) - Crop remnants (Celery, rhubarb etc.)

(3) - Ability of larvae younger than last instar to hibernate.

g - Possibility and extent of Spring feeding.

(1) - Corn stalks, cob or grain.

(2) - Stalks of other susceptible food plants.

(3) - Will pupae develop without such feeding.

h - Behavior of larvae in cut food plants during growing season.

Note:- Distinct from hibernation B-2-f-(a) and (b).

(1) - Corn stalks cut and piled.

(2) - Corn stubble pulled and left on surface of soil.

(3) - Weeds cut and piled.

(4) - Weeds cut and sprayed with fusil oil.

i - Reaction to water (See Dispersion - D-4-a-(2)....)

j - Miscellaneous larval habits.

(1) - Gregariousness (2) - Phototropism

(3) - Spinning. (4) - Cannibalism.

(5) - Boring capabilities in each instar.

(a) - In different plants used as food.

(b) - " material used as shelter or to escape from confinement - i. e. lumber, cloth, paper etc.

C - Pupa.

1 - Description.

a - male b - female.

2 - Location and position.

3 - Duration of pupal period.

a - male b - female.

4 - Reaction to water (See Dispersion - D-4-a-(3)....)

D - Adult.

1 - Life History

a - Description.

(1) - Male - typical and aberrant.

(2) - Female " " "

b - Proportion of sexes.

c - Duration of pre-oviposition period.

(1)-Period between emergence and first copulation.

(2)- " " first copulation and first oviposition.

d - Duration of oviposition period.

e - Longevity of adults.

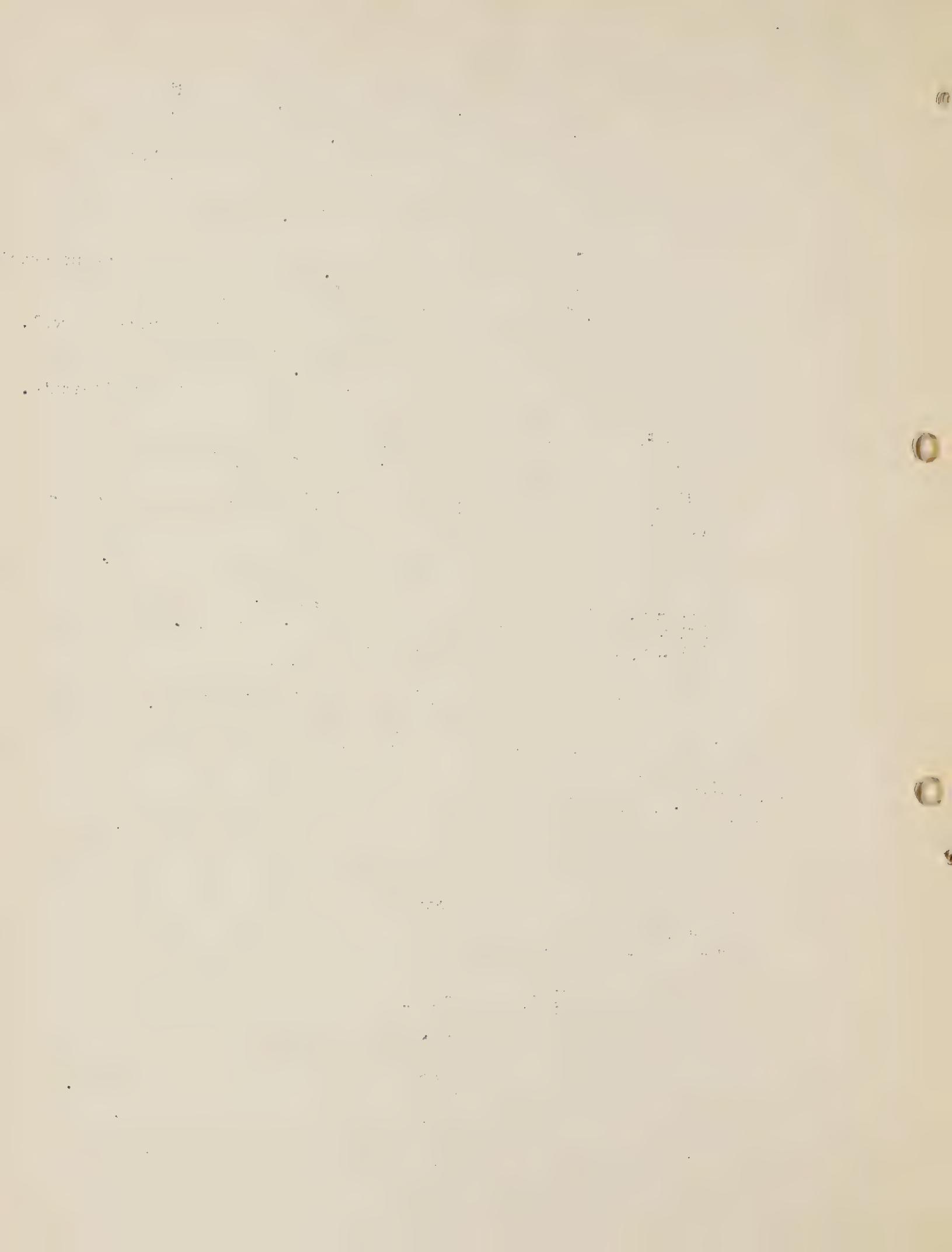
(1) - Male (2) - Female (3) - Unfertilized females.

(4) - Life of female after completing oviposition.

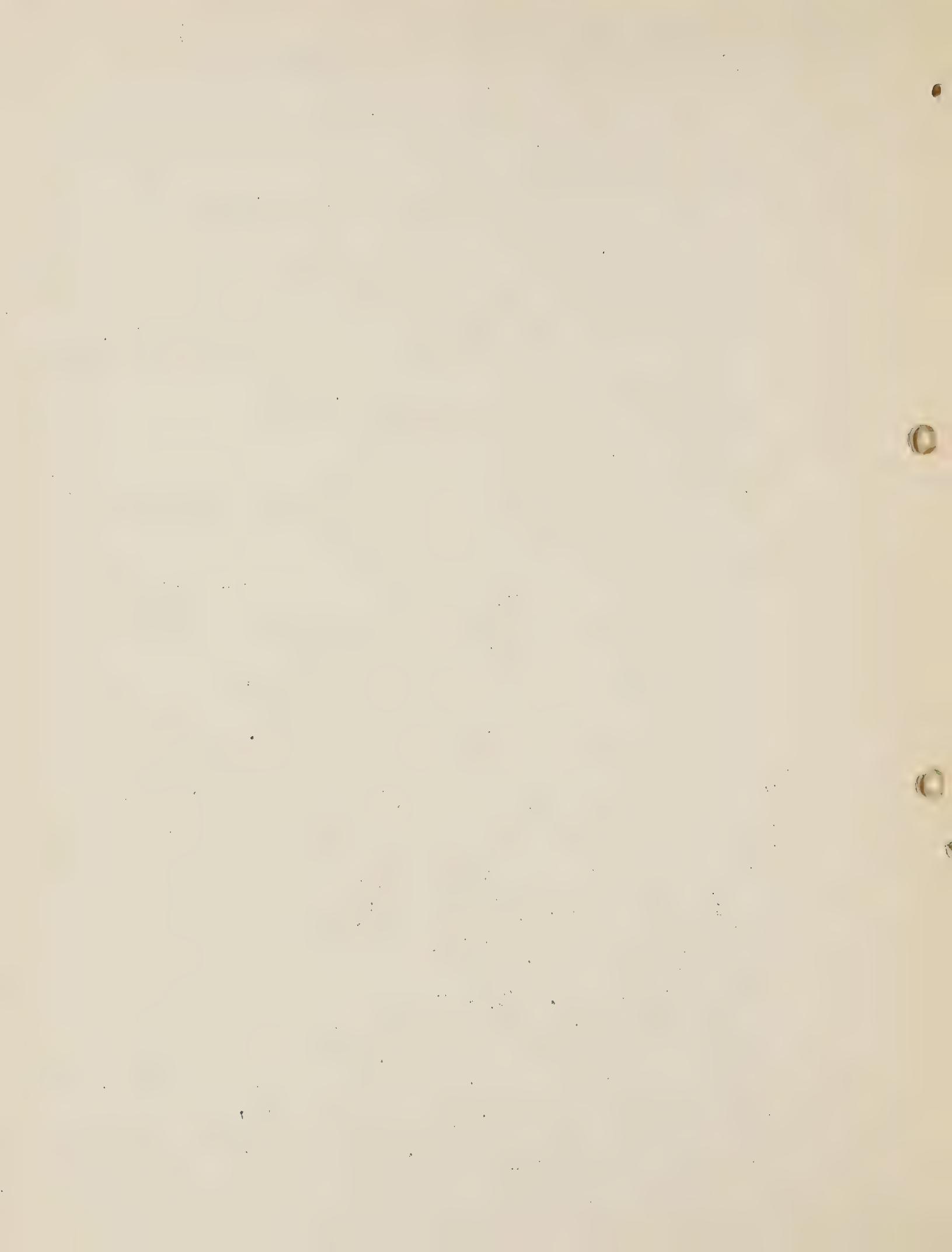
(5) - " " male " " copulation.

(6) - Length of life without food.

(a) - Male (b) - female.



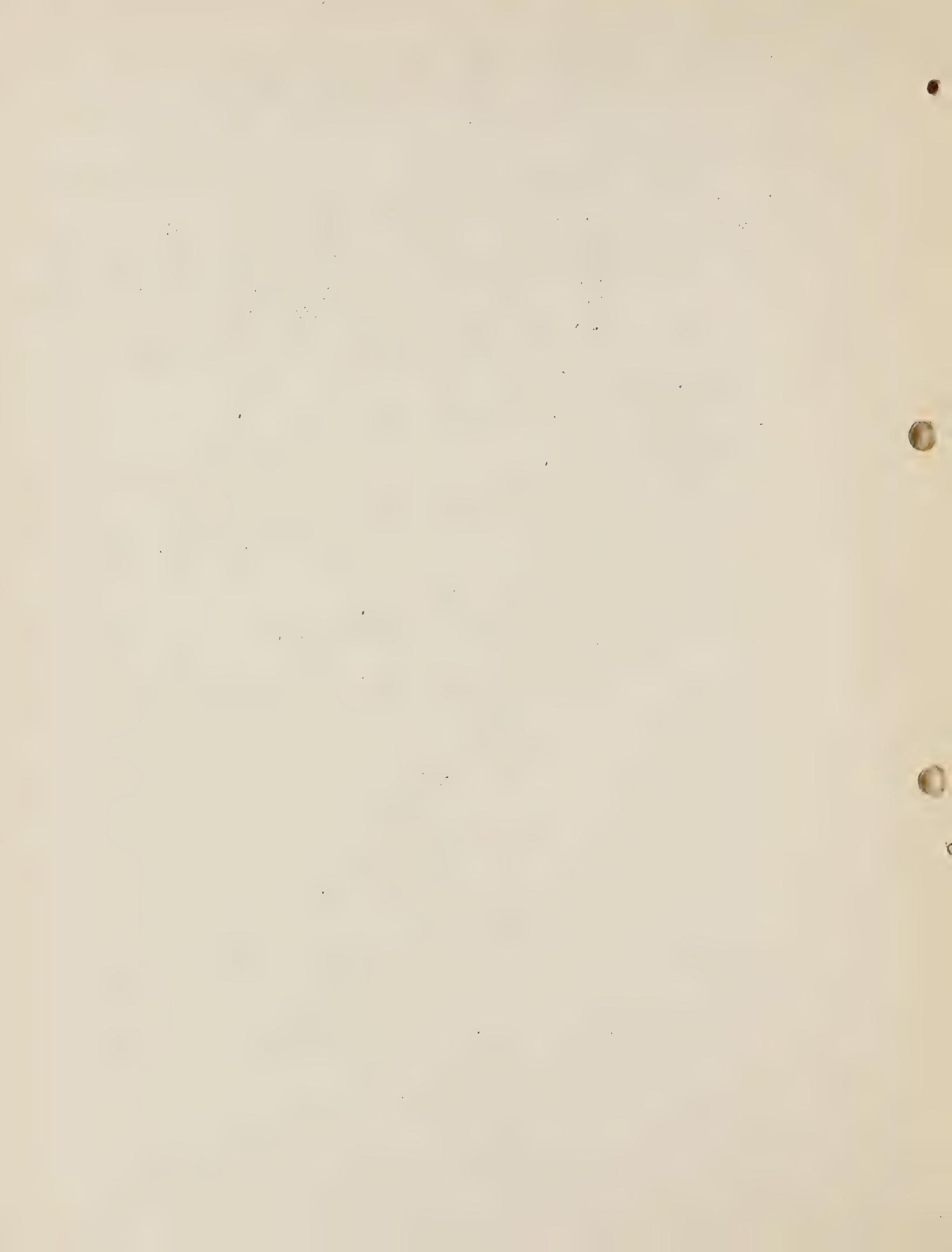
- 2 - Habits.
- a - Copulation.
- (1) - Manner
 - (2) - Length.
 - (3) - Time of greatest activity.
 - (4) - Number of matings to insure deposition and fertility of total complement of eggs.
 - (5) - Polygamy, polygyny.
- (a) - Number of females fertilized by each male.
 - (b) - " males accepted " female.
- b - Oviposition.
- (1) - Portion of host favored for oviposition.
 - (a) - Oviposition on material in which larvae do not feed i. e. cork, old corn cobs etc.
 - (2) - Method of oviposition.
- (a) - Number of eggs deposited at one time and their disposition.
 - (b) - Total number of eggs from each female.
 - (c) - Average " " per cluster.
 - (d) - Maximum and minimum eggs per cluster.
 - (3) - Daily rate of oviposition.
 - (a) - Number of ovipositions per day.
 - (b) - " eggs deposited per day.
 - (4) - Daily period of oviposition (day, evening, early morning)
 - (5) - Plants preferred for oviposition.
- c - Flight (See Dispersion - B-1 to 3)
- d - Attraction of adults.
- (1) - To lights.
 - (a) - Status of moths attracted i. e. males, females - gravid, spent, not fertilized.
 - (b) - Varying the kind of light.
 - (aa) - Colored lights vs. uncolored light.
 - (bb) - Sorch " masked "
 - (cc) - Moving " stationary "
 - (dd) - Weak " powerful light.
 - (ee) - Lights at different heights above ground.
 - (2) - Attraction to baits.
 - (a) - Fruits, syrups, oils, etc.
 - (b) - Macerated corn plants - in an attempt to isolate the substance which attracts the ovipositing females to corn plants.
 - (3) - Attraction of lights combined with baits.
 - (4) - " males to females.
- (a) - Daily period of greatest attraction.
 - (b) - Life Period of greatest attraction.
 - (c) - Distance of attraction.
 - (d) - Cause " "
- e - Miscellaneous adult habits.
- (1) - Feeding habits.
 - (a) - Necessity of food.
 - (b) - Kinds of food.
 - (c) - Time of feeding.
 - (d) - Relation between foods and length of life i. e. fruits, oils, etc.
 - (e) - Relation of foods to egg laying capacity.
 - (2) - Ability of adults to develop from larvae or pupae, and reach surface of soil after burial, or plowing under. Field and insectary investigations with corn, woods, crop remnants, etc. Cross ref. to "Control" - D.



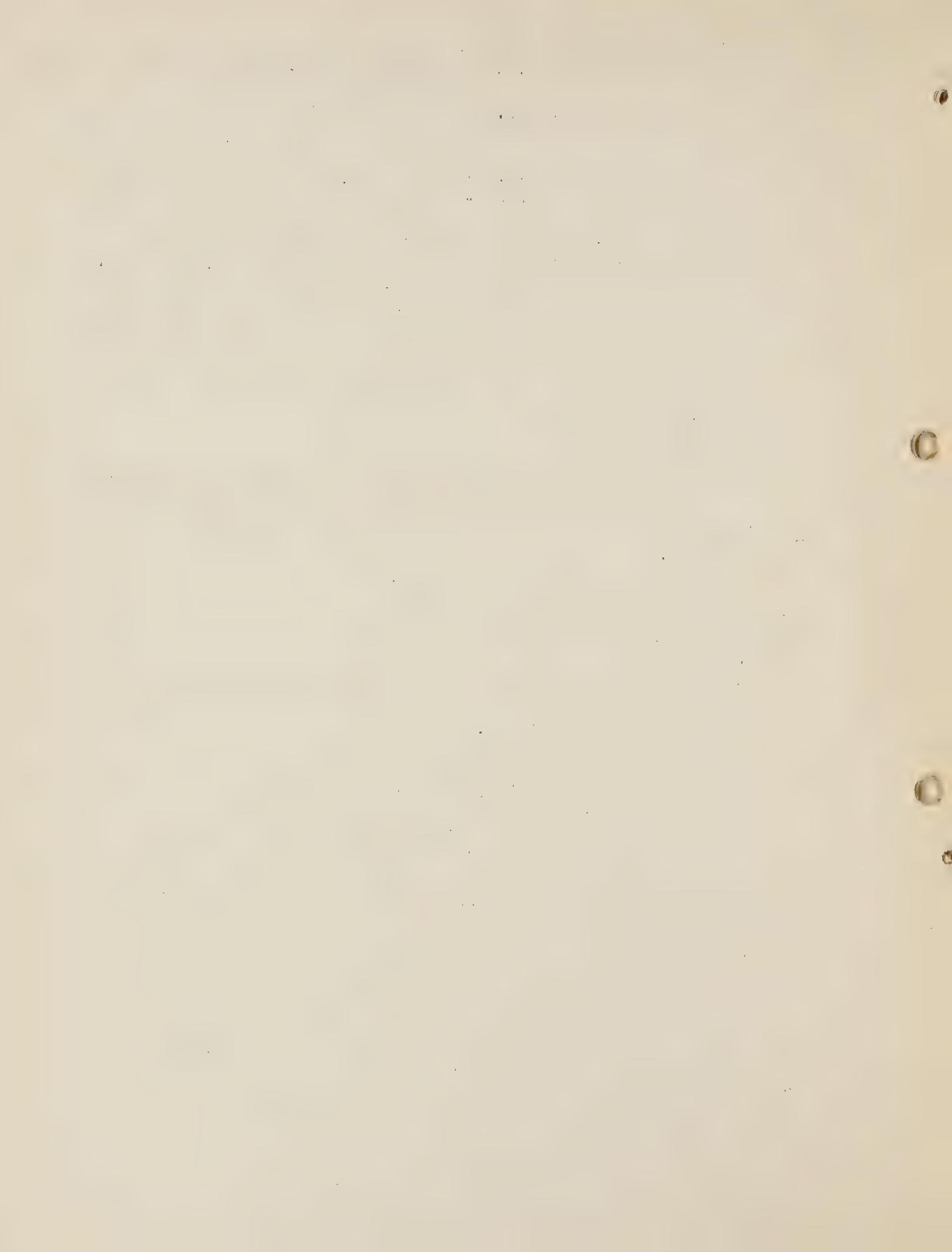
- (a) - Late Summer or Fall burial or plowing under.
- (aa) - Stalks buried, or plowed under, 2 to 18" deep.
 - (bb) - Stubble " " " 6 " deep.
 - (cc) - Entire plants, " " ". 6 to 12 " deep.
 - (dd) - Comparative efficiency of complete and incomplete burial, or plowing under, in (bb) and (cc).
 - (ee) - Comparative efficiency of planting cover crop (winter rye) after burial, or plowing under, in (bb) and (cc).
 - (ff) - Comparative efficiency of cutting off stubble level with soil and then burying, or plowing under, the cut off portion and remainder of stubble as in (bb) and (cc).
 - (gg) - Comparative efficiency of harrowing, discing or dragging surface of soil after plowing compared to leaving soil rough.
- (b) - Spring burial or plowing under.
Same as (a) - (aa) to (dd) and (ff).

E - Seasonal History.

- 1 - Seasonal abundance (See "Food Plants" - F- 1 to 3).
- 2 - Seasonal Development.
 - a - Hibernation (An addition to B-2-f)
 - (1) - Factors influencing hibernating larvae.
 - (a) - Condition and position of host plant (covered in detail under B-2-f- (a) and (b)...)
 - (b) - Age of larva.
 - (c) - Meteorological conditions.
 - (aa) - Temperature (See d-(2)-(g)...)
 - (bb) - Humidity.
 - (cc) - Freezing and thawing.
 - (aaa) - Determine activity and future development of larvae subjected to natural freezing conditions, within their burrows in corn.
 - (1.1.) - Observations on activity of larvae which are under freezing conditions at various temperatures in different localities and on various dates.
 - (2.2.) - Determine activity of these larvae when temperature is gradually raised to 80 deg. Fahr. in incubator. Will these larvae complete their development?
 - (3.3.) - Determine effect on these larvae when temperature is suddenly raised from freezing conditions to higher temperatures. Will these larvae complete their development?
 - (bbb) - Same experiments as in (aaa) to be carried on with host plants other than corn.
 - (ccc) - Larvae free. Same as (2.2.) and (3.3.).
 - (ddd) - Determine activity and future development of larvae when subjected to freezing in blocks of ice, within their burrows in corn.
 - (1.1.) - Observe activity of larvae during freezing process.



- 7
- (2.2.) - Effect on larvae when frozen for various periods of time.
- (3.3.) - Effect on larvae when gradually thawed from these conditions. Effect of re-freezing and thawing several times.
- (4.4.) - Same as (3.3.) when suddenly thawed.
- (5.5.) - Determine whether these larvae will complete their development.
- (eee) - Same experiments with other host plants.
- (fff) - Larvae free. Same as (2.2.), (3.3.) and (4.4.).
- (ggg) - Conduct experiments along same lines as in (ddd) to determine effect of freezing conditions on larvae inhabiting moist stalks (very low and wet ground)
- (l,l,) - Dipping stalks in water and freezing immediately.
- (dd) - Rain.
- (ee) - Snow.
- (ff) - Wind.
- (d) - Conduct experiments to determine percentage of larvae surviving winter conditions in corn, and a few other host plants, in several localities over entire winter period.
- b - Nestivation.
- (1) - Stage.
- (2) - Factors influencing nestivation.
- (a) - Temperature (b) - Humidity.
- c - Number of generations annually.
- (1) - Under field conditions.
- (2) - " lab. "
- (3) - Possible factors contributing to difference in number of generations between Mass. and N. Y.
- (a) - Climatic conditions.
- (aa) - Altitude (as affecting climate)
- (bb) - Meteorological conditions.
- (aaa) - Correlation of life zone limits.
- (bbb) - " frost " "
- (ccc) - " temperature
- (ddd) - " humidity
- (b) - Heredity.
- (aa) - Source of original infestation i. e. Europe, Asia, Mass. or Canada
- (bb) - Number of generations in that locality.
- (4) - Transfer adults or pupae from eastern New York and Western N.Y. areas to Arlington. Rear progeny from each locality in a separate, large out door cage. This may be continued for two or more years to determine effect of Arlington environment on the one generation New York progeny, always using the progeny of the original material from N. Y.
- d ----- Factors influencing seasonal development.
- (1) - Climatic conditions.
- (a) - Altitude.
- (b) - Meteorological conditions.
- (2) - Relation of temperature to development.
- (a) - Developmental zero for each stage.
- (b) - Optimum.
- (c) - Thermal constant for each stage.
- (d) - Plot curves showing rate of development.



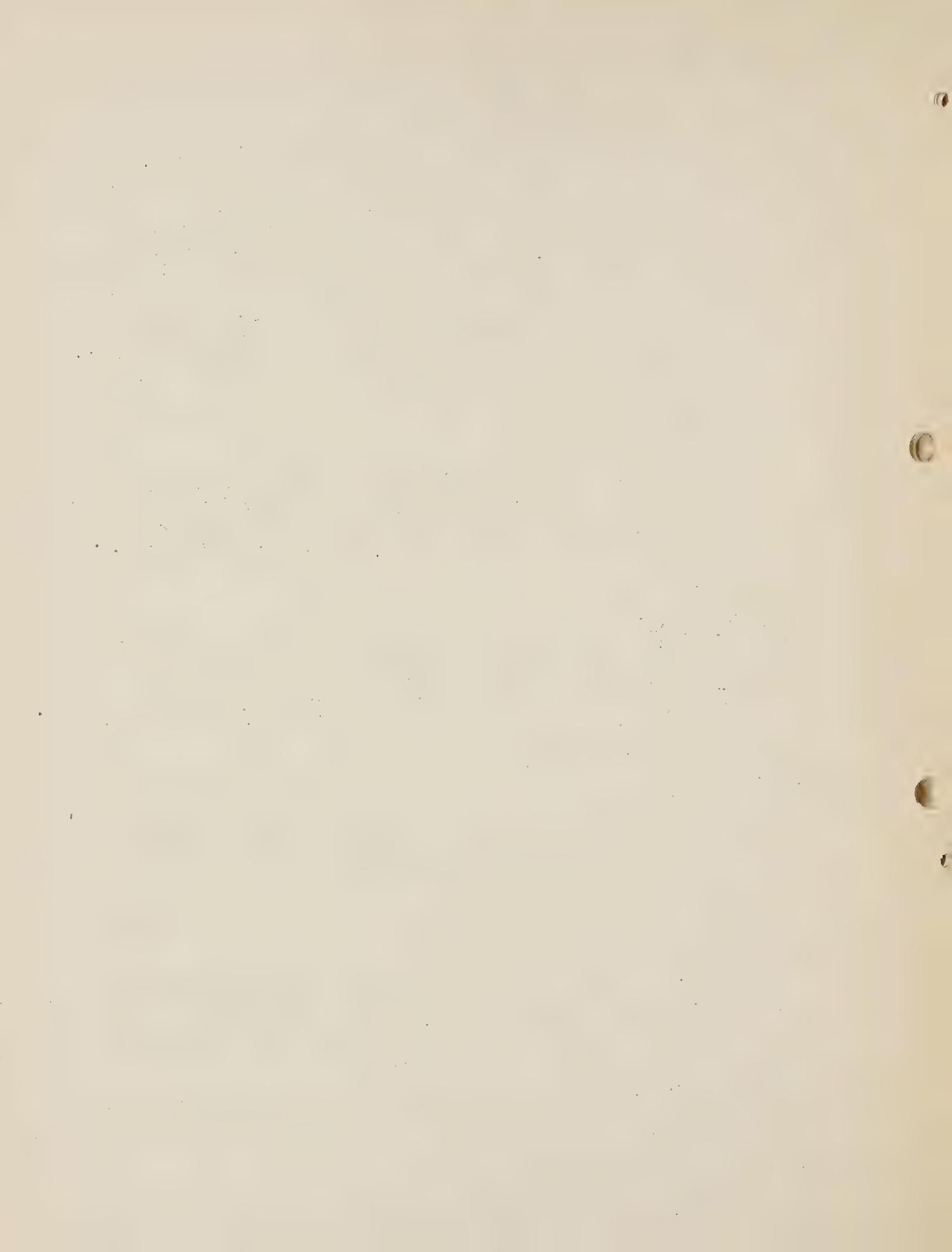
- (e) - Total degrees of effective temperatures required to complete each stage.
- (f) - To complete entire life-cycle.
- (g) - Relation of hibernation to temperature.
 - (aa) - Amount of low temperature required for hibernation and subsequent pupation.
 - (bb) - Effect of absence of low temperature on hibernating larvae and on subsequent pupation.
 - (cc) - Relation between the duration of low temp. periods during hibernation to rate of development after hibernation.
 - (dd) - Amount of effective temperatures required to complete larval stage after hibernation.
- (h) - Relation of aestivation to temperature.
- (i) - " general activity, to "
- (3) - Heredity
- (4) - Food
- (5) - Light
- e - Phenology - First and last record of occurrence in field and laboratory in each generation. Also period of maximum occurrence in the field.
- (1) - Egg. (2) .. Larva. (3) - Pupa. (4) - Adult.

IV - DISPERSION.

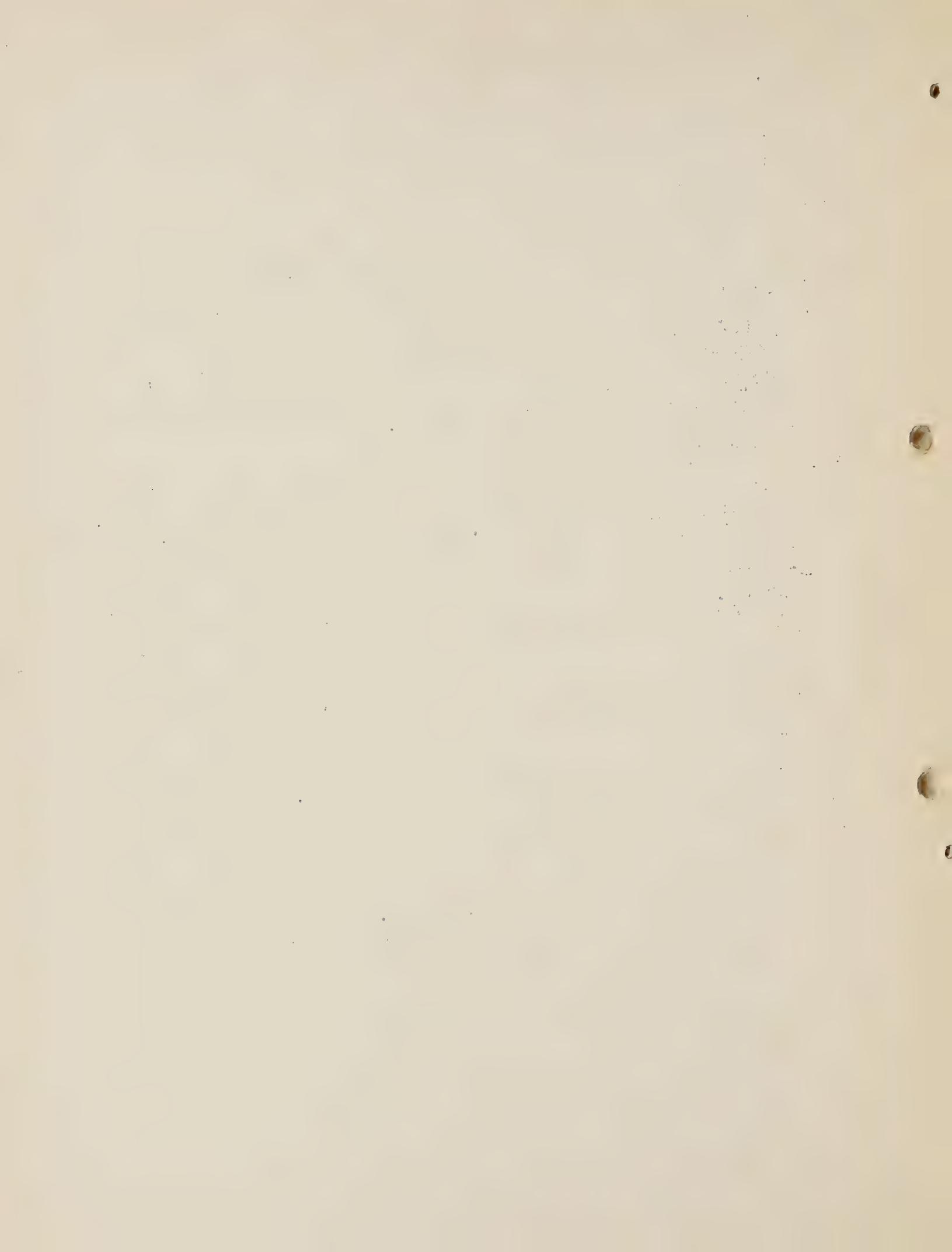
Assignment: - Mr. O'Rourke and assistants.

- A - Data on seasonal distribution (all stages).
 - 1 - Increase in infested area by each generation (notes and maps)
 - 2 - Distances of dispersion to the N, NE, E, SE, S, SW, W, and NW.
Plot curves.
 - a - Generation by generation.
 - b - Total of all generations.
- B - Flight (Adults).
 - 1 - Distance of flight.
 - a - Liberation of marked male adults in lightly infested territory followed by systematic trapping at varying distances and different directions from point of liberation to secure records on distance of flight of the male moth.
 - (1) - Use of the tanglefooted assembly cage containing newly emerged virgin females.
 - (2) - Use of trap lights.
 - b - Liberation of marked female adults at the West Medford experimental plot followed by systematic sweeping and trapping at varying distances and different directions from the experimental plot to secure records on distance of flight of the female moths.
 - (1) - Use of men sweeping with hand nets.
 - (2) - Use of trap lights.
 - c - Detailed study of distance capable of flight (horizontally in single flight or in series of flights, by males, gravid, spent, unfertilized or immature females.
 - (1) - In presence of favorable wind.
 - (2) - In absence of wind.
 - (3) - Under favorable wind conditions.

Note: - Liberate individual moths on a long beach at the seashore or on a smooth open field and observe points mentioned above.



- 2 - Study of the nature of flight.
- a - Character of flight.
 - b - Single flight and series of flights.
 - c - Height of flight.
 - d - Direction in relation to the prevailing wind.
 - e - Daily period of the greatest flight activity.
- 3 - Influences of weather on flight.
- a - Relation of temperature.
 - b - Relation of humidity.
 - c - Relation of fair, warm weather to flight activity.
- C - Relation of Artificial and Common Carrier to Dispersion.
- 1 - Larvae.
- a - Observation to determine if larvae will crawl upon trains, cars, automobiles, or other vehicles while standing still.
 - b - Distance capable of being carried.
- 2 - Adults.
- a - Observation to determine if adults will alight upon trains, cars, automobiles or other vehicles.
 - (1) - While standing still.
 - (2) - While moving at varying rates of speed.
 - b - Distance capable of being carried.
- D - Relation of Water Drift to Dispersion of host plants or other material.
- 1 - Data on tide ocean and harbor currents off the coast of eastern North America between New York Bay and the Gulf of Newfoundland, with special attention to those in Massachusetts Bay and off the Massachusetts coast.
- a - Correlate with distance and situation of coastwise infestation.
 - b - Determine probable dispersion through drift carried by these currents.
- 2 - Data on currents in Lake Erie.
- a - Correlate with distance and situation of infestation in New York, Pennsylvania and Canada.
 - b - Same as 1-b.
 - c - Throw 100 or more marked cornstalks into Lake Erie on the Canadian side in the vicinity of Port Stanley, Ontario. Follow by thorough scouting on the beach on the New York side for possible recoveries.
- Object: - To determine whether Western New York and Penn. infestations originated from drifting material from Canada.
- 3 - Field observations.
- a - Scouting banks of rivers, lakes, ponds, ocean beaches and islands for infested host plants, or other material, cast up by water.
 - (1) - Eggs. (2) - Larvae. (3) - Pupae.
 - (a) - Determine whether stages found are living and normal
(also covered under 4-a)
- 4 - Experimental observations.
- a - Drowning experiments - fresh and salt water.
 - (1) - Eggs.
 - (a) - Total immersion. (b) - Floating.
 - (c) - Determine whether larvae will hatch from egg-masses while floating,
 - (2) - Larvae.
 - (a) Total immersion in host plant tunnel.
 - (b) - " " free



- (c) - Floating material containing larvae.
- (d) - " larvae free.
- (e) - Determine whether larvae will pupate.
- (aa) - While totally immersed.
- (bb) - After total immersion.
- (cc) - While floating.
- (dd) - After "

(3) - Pupae.

- (a) - to (e) same as under (2) except emergence of adults under (e).

(4) - Adults

- (a) - Determine whether adults which have emerged from these pupae are normal and can reproduce.

(b) - Total immersion.

- (aa) - Effect upon flight.

- (bb) - " " fertilization and oviposition.

(c) - Floating.

Same as (b) - (aa) and (b) - (bb)

E - Relation of wind currents to dispersion.

1 - Obtain data on wind currents from local meteorological station.

- Work up and plot curves.

2 - Correlate with distances of dispersion. Plot curves.

F - Possible dispersion thru infested plants or their products in commerce (Artificial carriers)

1 to 6 - Same as "Food Plants". I - 1 to 6 as applied to observations made after the plant, or its product, enters commerce.

- Before that period it pertains to "Food Plants".

7 - Shelled corn containing portions of cobs, or free larvae (covered partly in "Food Plants" - I to 1 - grain.)

G - Migration of larvae (See "Life History and Habits" - B-2-b)

Note:- Larval migration is believed to have but very little influence on Dispersion when interpreted in its broadest sense. If notes are written on this subject they should be headed "Life History and Habits"

H - Effects of local physical features and terrain on dispersion.

1 - Natural barriers.

a - Bodies of water.

b - Forests and wooded areas.

c - Barren lands, as sand dunes; marshes,

d - Highlands, as high hills, mountain ranges.

e - Non-continuity of favored food plants.

2 - Artificial barriers.

a - Cities; towns; groups of buildings etc;

3 - Determination of favorable channels for dispersion.

a - Continuity of favored food plants. b - Coastal plains.

c - River valleys.

4 - Effect of farming type on dispersion.

a - Market gardening district.

b - Truck and fruit farming district.

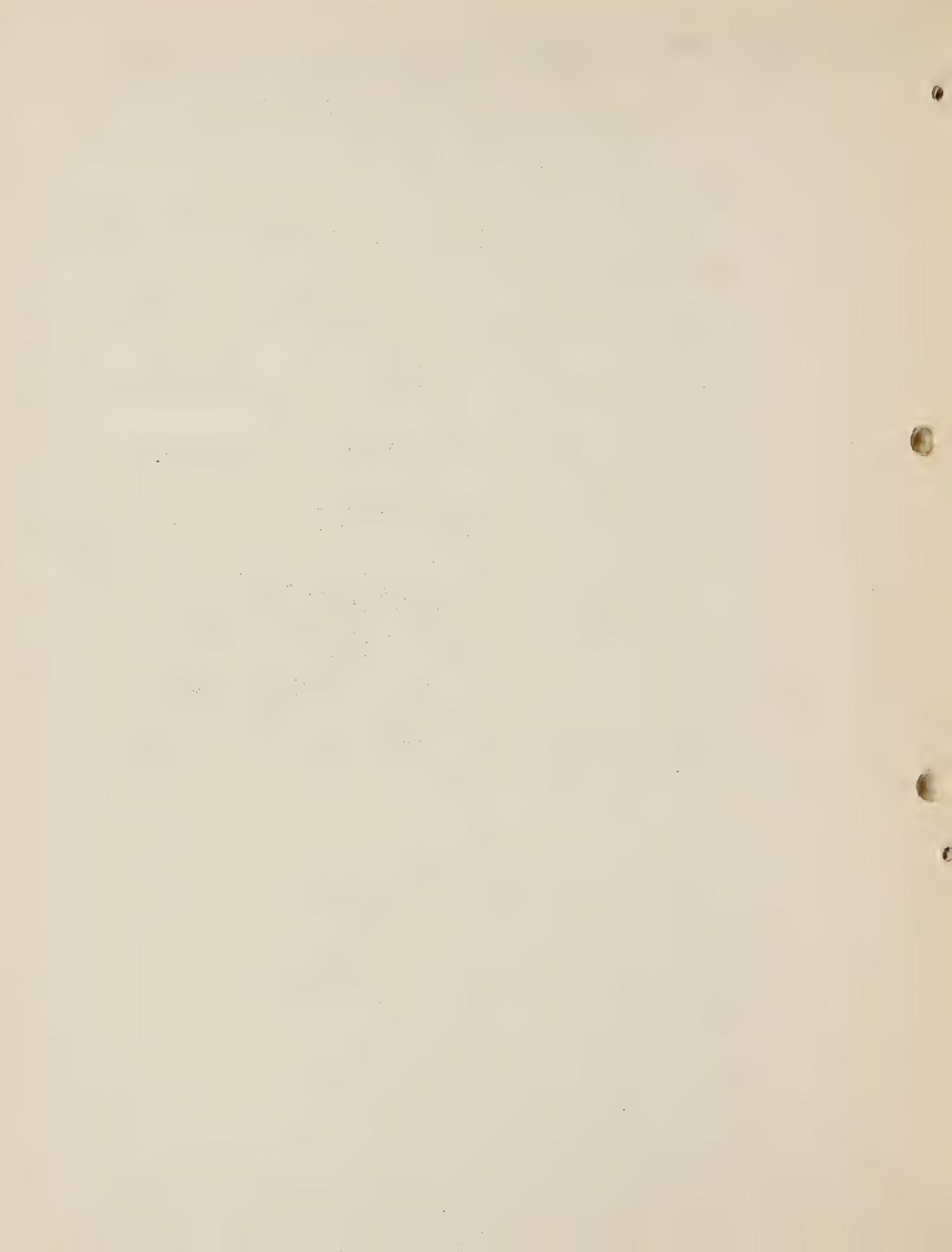
c - General farming district.

d - Grain and dairy farming district.

e - Farming in isolated wooded or barren areas.

I - Percentage of infestation.

Object: - To ascertain the increase or decrease of the insect in the same areas from year to year and from generation to generation. Using corn as a basis and possibly some of the more susceptible weeds. Also any generally infested economic crop other than corn.



1 - Field Counts - in each generation.

a - Ascertain the average percent of infestation in each field or area by examining a definite number of plants situated at different representative parts of the field or area. (Avoid duplication of "Food Plants")

- (1) - Location of field-town; address, owner etc.
- (2) - Kind of corn-sweet, field etc. and variety when possible.
- (3) - Species of weeds, or economic plants other than corn (when counts are made of these plants).
- (4) - Character of terrain-cultivated, dump, waste area, level, sloping steeply, sloping gradually etc.
- (5) - Proximity to other species or groups of infested plants.
- (6) - Type of soil-light, heavy, sandy, gravel etc.
- (7) - Approximate altitude - high, low etc.
- (8) - Percentage of plants infested.
- (9) - Average number larvae per plant.
- (10) - Maximum " " " " examined.

b - Ascertain the percentage of increase or decrease of infestation in areas where clean-up, or other control work, has been carried on. (1) to (7). Same as a - (1) to (7).

c - Ascertain relative degree of infestation of the same host plant in different localities and compare from year to year. (Avoid duplication of "Food Plants" - G-4 and make cross reference to that subject specifying definitely the plants concerned.)
(1) to (10) Same as a - (1) to (10).

d - Incorporate data secured in "a" to "b" in a statistical survey of the relative degree of infestation in each town. Compare from year to year.

2 - Stubble counts of corn - in each generation.

a - Percent of stubble infested using same method as in 1-a.

- (1) - Location of field or area - Town, address, owner etc.
- (2) - Kind of corn - Sweet, field etc - also variety when possible.
- (3) - Height of stubble.
- (4) - Approximate date of cutting.
- (5) - Character of cultivation - weedy, clean.
- (6) - Proximity to other infested standing plants, or stubble. Especially the presence of standing corn, or corn stubble of a different planting, in adjoining area. Also presence of infested weeds, or weed stubble, among corn stubble examined, or in adjoining area.

b - Compare percentage of stubble infestation with counts secured from previous counts of entire plants in same area.

3 - Larval counts in heavily infested fields and areas-each generation.

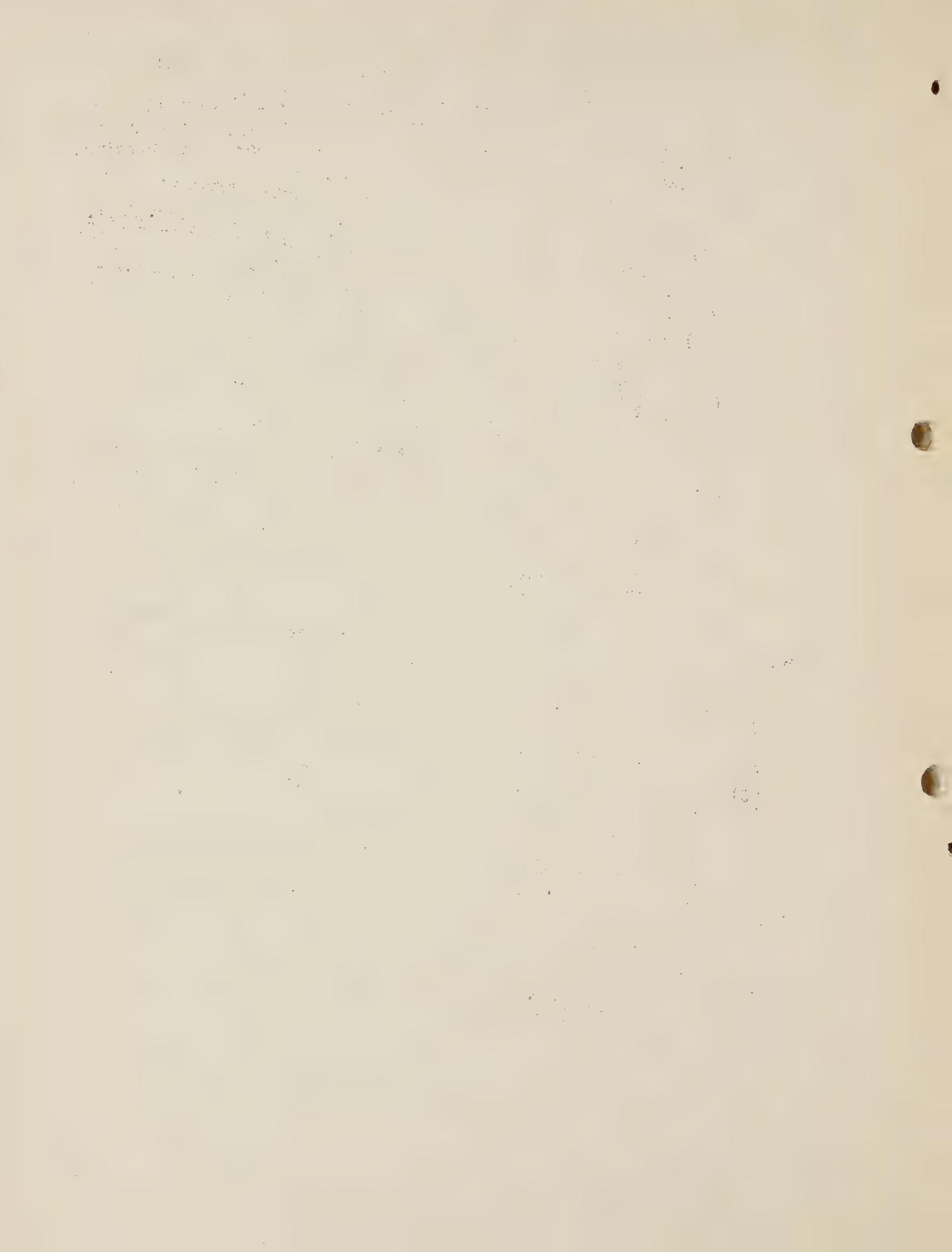
Note:- Avoid duplication of 1-a; 1-b; and 1-c;

a - Same as 1-a (1) to (10).

J - Classification of infested area.

1 - Classification and mapping of infested area into three classes according to the intensity and character of the infestation. The approx. size of area in each class to be indicated. Compare relative size of area in each class and its distribution from year to year.

Note:- No definite effort needed to secure information for this work. Sufficient data should be available from the general and detailed observations made throughout the year by laboratory men, field scouts and quarantine inspectors.



- a - Class 1 - Area in which corn, weeds, grasses, flowering plants, and crops other than corn are heavily infested.
- b - Class 2 - Area in which the infestation is confined to corn with a small percentage of infestation in susceptible economic plants, other than corn, and weeds.
- c - Class 3 - Area in which the infestation is confined almost exclusively to corn.

V - FOOD PLANTS.

Assignment: - Messrs Hodgson, Grigg, Sanderson and assistants.

A - Determination

- 1 - Herbarium. 2 - Collection of mature specimens. 3 - Collection of seeds.

Object: - These collections are of host, and likely host plants for use in determining infested material brought in at any time of year.

B - Lists of infested plants.

- 1 - Alphabetical. 2. Systematic.
- 3 - Classified; i. e. indicating relative susceptibility, nature of infestation; frequency of occurrence; shelter plants etc.
- 4 - Plants found in other areas.

a - Schenectady. b - Buffalo. c - Canada. d - Europe.

Note: For total number of species and varieties found containing larvae consult B-1. For families and genera represented consult B-2.

C - Summary record chart for each of important host plants.

- 1 - Showing generation and life stages found on, or in, each plant. Also whether used for hibernation or aestivation.
- 2 - Giving degree or "index" of infestation as compared with corn determined as an average from the field percentage and comparative infestation counts.
- 3 - More important information on plant as its botanical relationship, commercial value and uses.

Object: To have a ready reference to infestation status and commercial importance of each plant for use in quarantine and control work.

D - Exhibition material.

- 1 - Jars containing each species and important variety and showing typical infestation in each.
- 2 - Reserve material of corn and a few of the other more important host plants for outside requests.
- 3 - Experiments with preservation of natural colors.

E - Groups of plants for investigation.

1 - Economic.

- a - Field and garden crops (native, southern, western)
- b - Ornamentals (flowers, foliage plants, shrubbery etc)
- c - Greenhouse (flowers, vegetables, fruits)
- d - Fruits of trees, bushes and vines.

Note: See also "Plan of Expt. Plots" for (a) and (b).

2 - Non-economic.

- a - Garden escapees, volunteer grains etc.
- b - Weeds of cultivated land, dumps and waste areas.
- c - Wild plants of fields, meadow, pasture, woodland.
- d - Marsh and water plants.
- e - Shrubs, berry canes, vines etc (Some of these may be of economic importance at times such as blackberry and elderberry)



F - Seasonal abundance of insect.

1 - Due to generation of insect.

2 - " condition of plant.

3 - " abandonment for now food supply.

G - Plants used as food for larva.

1 - Plants upon which eggs have been found (Distinct from "Life History and Habits" - D-2-b-(5), etc.)

a - With subsequent feeding.

b - Without.

2 - Parts of plant attacked as related to seasonal growth of plant and seasonal development of insect.

3 - Duration, extent, nature and appearance of infestation.

4 - Proportion of plants attacked in heavy, medium and lightly infested areas.

Note:- This runs into "Dispersion" I -l-a and c.

Information obtained from this section should be cross referenced to "Dispersion". Desirable to leave as much of this activity as possible to men working on "Dispersion" except plants which they do not cover. Have an agreement with that section to avoid duplication in making field observations or counts of this character.

5 - Relation of certain food plants to vitality and future development of insect.

a - Directly.

b - Over several generations.

H - Plants used as shelter for larva.

1 - Protection afforded as place for hibernation or aestivation.

2 - Plants serving for food and " " "

3 - " " " only for " " "

I - Artificial carriers (egg, larva or pupa)

1 - As food (vegetables; greens; tubers; fruits; grain; forage etc)

2 - Decoration (cut flowers; plants; everlasting; grasses, etc)

3 - Propagation (shrubs; berry bushes; vines; perennials; bulbs; roots; cuttings etc)

4 - Manufacture (Broom Corn; medicinal herbs; hemp; etc)

5 - Packing and Bedding (hay; straw; woods; etc)

6 - Waste (garbage; manure containing litter; garden refuse, etc)

Note:- Observations under g to be considered as coming under "Food Plants" only when the examination is made before the plant, or its product, enters commerce. After that period it pertains to "Dispersion" F-1 to 6)

J - Comparative infestation.

1 - Between species (Field observations, exp. plots and cages)

a - Percent of infestation.

b - Average number of larvae per plant.

Note:- Be sure and cross reference to "Dispersion-Field Counts".

2 - Between varieties - (Chiefly at exp. plots with varieties of corn and the sorghums- "See Plan of Exp. Plots")

a - Same as J-1-a.

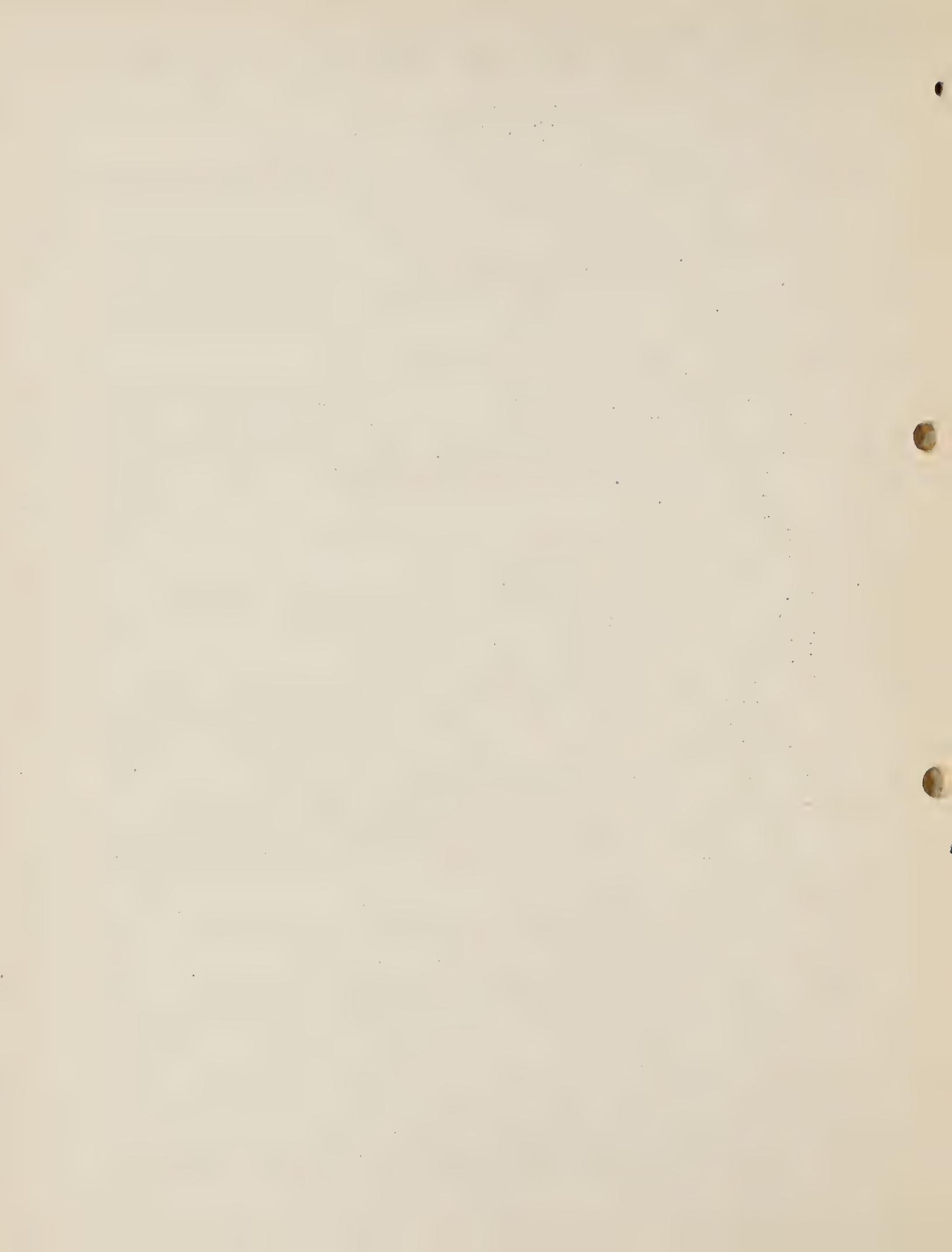
b - " " J-1-b.

3 - Proximity to corn as affecting degree of infestation.

a - Economic crops at varying distances.

b - Woods in corn areas, or at varying distances.

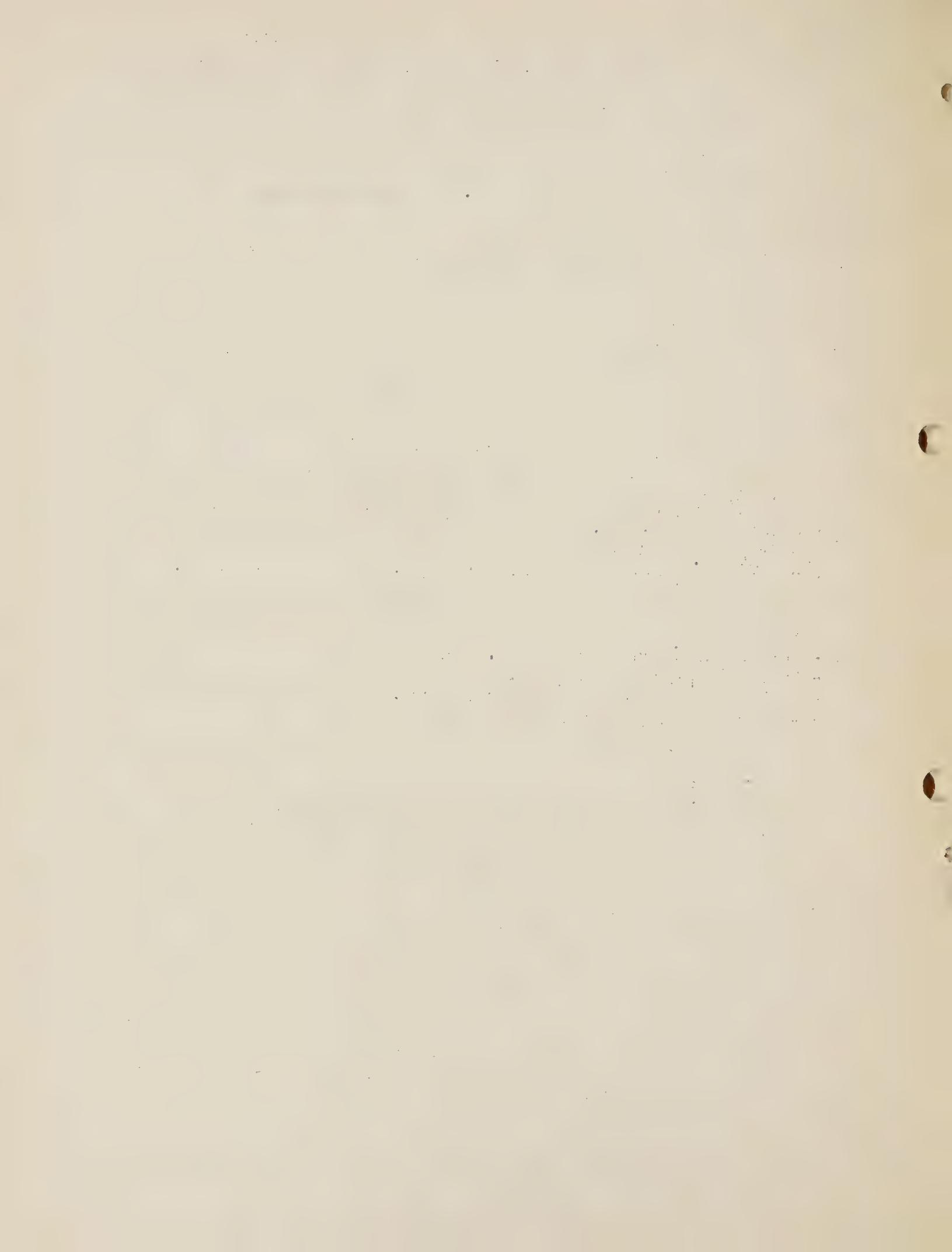
Note:- Notes should be under "Habits Larvae - Migration" and "Dispersion-Flight" if written as an individual note.



- 4 - Relation between time of planting and degree of infestation
- (See also "Plan of Exp. Plots")
- K - Economic loss (See "Statistics - Crop Losses")

VI - GENUS PYRAUSTA.

- Assignment: - Messrs W. O. Ellis, Turner and assistants.
- A - List of species occurring in U. S.
 - 1 - Original descriptions compiled,
 - 2 - Synonomy of the American species.
 - 3 - Species and their food plants now known. Also specify host, or shelter plants.
 - 4 - Bibliography.
 - B - Members of genus occurring in New England.
 - 1 - Distribution of each.
 - 2 - Examination of specimens in the Peabody, Boston and private collections.
 - C - Active search for larvae and rearing those found to occur
 - 1 - Food or host plants (See also A-3)
 - a - Food or host plants of P. nubilalis yet hosts of other species likely to be confused with P. nubilalis.
 - b - Food or host plants in which P. nubilalis has not been found.
 - 2 - Present and probable future economic importance of those found.
 - 3 - Habits and behavior.
 - a - Trophisms, b - Spinning habits,
 - c - Relative activity. d - Tractibility. e - Gregariousness.
 - 4 - Any native parasites reared to be turned over to parasite section for possible recovery records.
 - D - Pyrausta larvae.
 - 1 - Borers throughout larval life.
 - 2 - Surface feeders exclusively.
 - 3 - Influence of boring habit on structure.
 - a - Structures rudimentary on surface feeders yet well developed in borers; vice versa.
 - b - color.
 - c - Correlation between boring and surface feeding.
 - (1) - Possible natural grouping of larvae according to methods of living and the comparison of such an arrangement with the present artificial grouping.
 - E - Eggs
 - 1 - Descriptions, 2 - Figures
 - F - Anatomical study of the larvae now known.
 - 1 - Structural differences.
 - a - A key for their separation.
 - 2 - Description.
 - 3 - Figures.
 - G - Pre-pupal periods,
 - 1 - Formation and description of cocoons.
 - H - Pupae.
 - 1 to 3 Same as E-1 to 3.
 - 4 - Location with reference to host.
 - I - Adults.
 - 1 - Comparative anatomical study of the genitalia and wing venation
 - a - A key for their separation based on above.
 - 1 - Pyraustids from trap-light.
 - 2 - " captured by net in the order of their numerical superiority.



- 2 - Mate species collected alive or reared.
a - Secure data on their life history and habits.
 - 3 - Attempt to cross breed P. nubilalis with P. ainslici, fissalis, acglalis.
 - J - Cross breed P. nubilalis sexes from Schenectady, Silver Creek and Arlington.
 - K - Possible development of P. nubilalis races resulting from continued feeding on certain plants other than corn.
 - L - Associated Insects.
- Note:- This subject appears to be inseparable from "Genus Pyrausta" but notes dealing with other than members of the genus should have "Associated Insects" as their subject.
- 1 - Determine superficial characters for separating larvae of insects resembling P. nubilalis and which are often confused with that insect from similarity of appearance or injury caused
 - a - Data on their seasonal history and habits.

VII - PARASITES

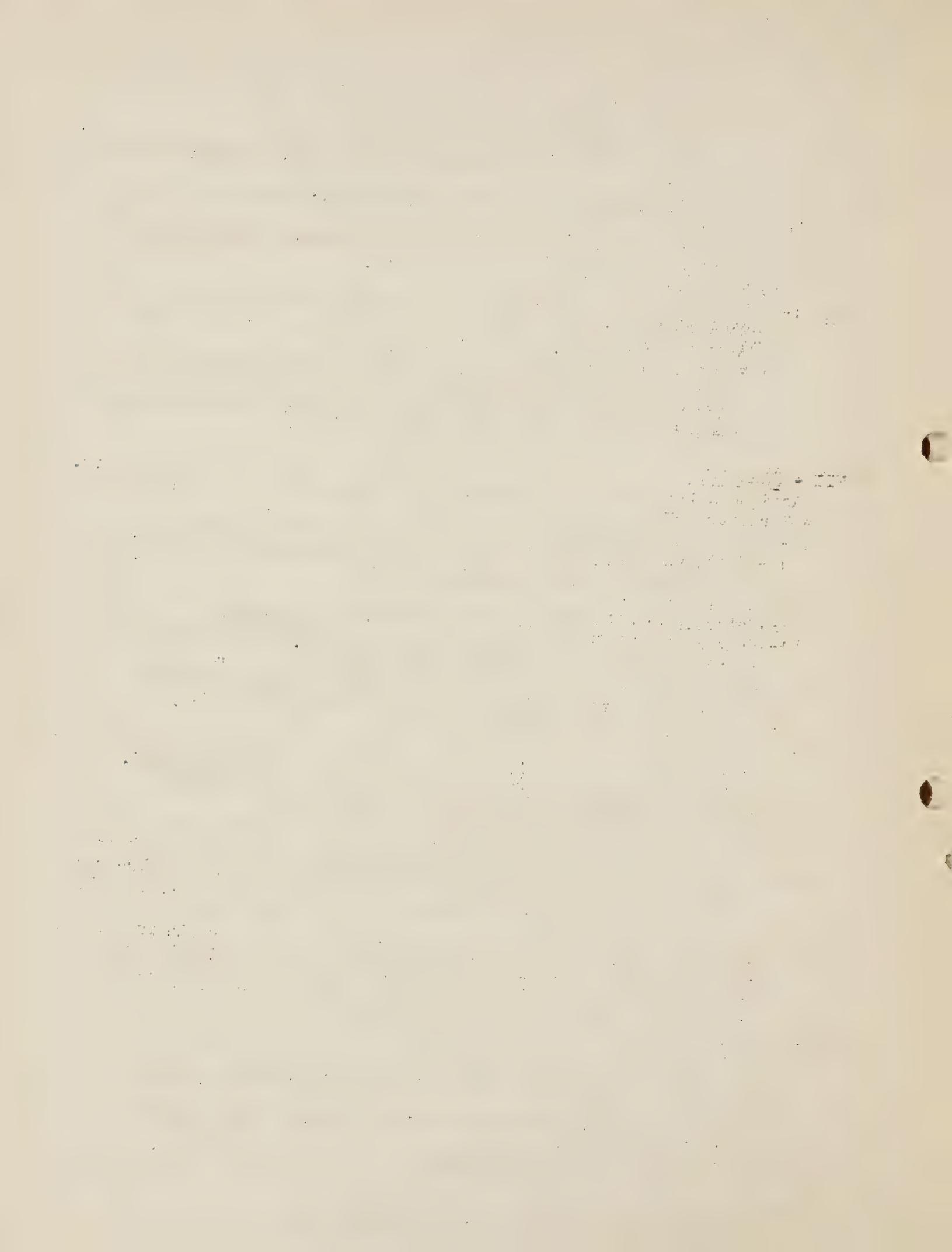
Assignment: - Messrs Jones, Parker, R. C. Ellis, Craig and assistants.

A - Parasites - Native.

- 1 - Larval and pupal parasites of the second 1920-1921 generation.
 - a - Notations on all parasites reared from collections of material made in the Autumn of 1920 and Spring of 1921.
- 2 - Egg parasites.
 - a - Determination of method of hibernation of T. minutum.
 - b - Four collections of 50 egg masses each from 10 representative heavily infested towns of first 1921 brood.
 - c - Two collections of 15 egg masses each from 10 representative medium to moderately infested towns of first 1921 brood.
 - d - Same as b for second 1921 brood.
 - e - " " c " " "
 - f - Investigations of life history of T. minutum as related to P. nubilalis and all other hosts in New England.
 - g - Breeding T. minutum under laboratory conditions.
 - h - Possible importation from Southern U. S. early in the season of insect eggs parasitized by T. minutum.

Object: - An attempt to increase the normal parasitism of first brood eggs with the consequent increase of parasitism in second brood eggs. Normally this parasite is present in only very limited numbers in first brood eggs.

- i - Attempt to achieve same result as detailed in h by placing in cold storage quantities of parasitized second brood of 1921 eggs, or possibly parasitized eggs of a more favorable insect for cold storage purposes. These eggs to be held over until Spring of 1922.
- 3 - Larval parasites.
 - a - Collections in 20 towns of 100 first to third instar larvae of first 1921 brood for rearing of possible Braconid parasites. Environs of Saugus especially.
 - b - Collections of 200 nearly mature larvae of first 1921 brood in 20 representative towns.
 - c - Same as a for second 1921 brood.
 - d - " " b " " "
- 4 - Pupal parasites.
 - a - Collection of 100 pupae of second 1920-1921 generation from 20 representative towns.



- b - Same for pupae of first 1921 generation.
- 5 - Results of 1920 liberation of Braconid parasites reared from P. nubilalis sent from Illinois.
- a - Bulk collection of hibernating larvae from Saugus otherwise 3 will suffice.
- B - Parasites - Foreign.
 - 1 - Investigations with such foreign parasites as may be received from abroad relative to their utilization in combating P. nubilalis in America.
 - 2 - Egg parasites.
 - a - Rearing. b - Colonization.
 - 3 - Larval Parasites.
 - a - Rearing.
 - b - Colonization and information regarding colony sites.
 - c - Recovery.
 - (1) - Bulk collections of both larval broods near colony sites.
 - d - Dispersion.
 - (1) - Larval collections under A-3 will suffice.
 - e - Life History studies.
 - 4 - Pupal parasites.
 - a - to 3 - Same as 3-a to e

VIII - PREDATORS.

- Assignment - Laboratory staff.
- A - Birds.
- B - Insects.
- C - Animals.
- D - Other predators.

IX - DISEASE.

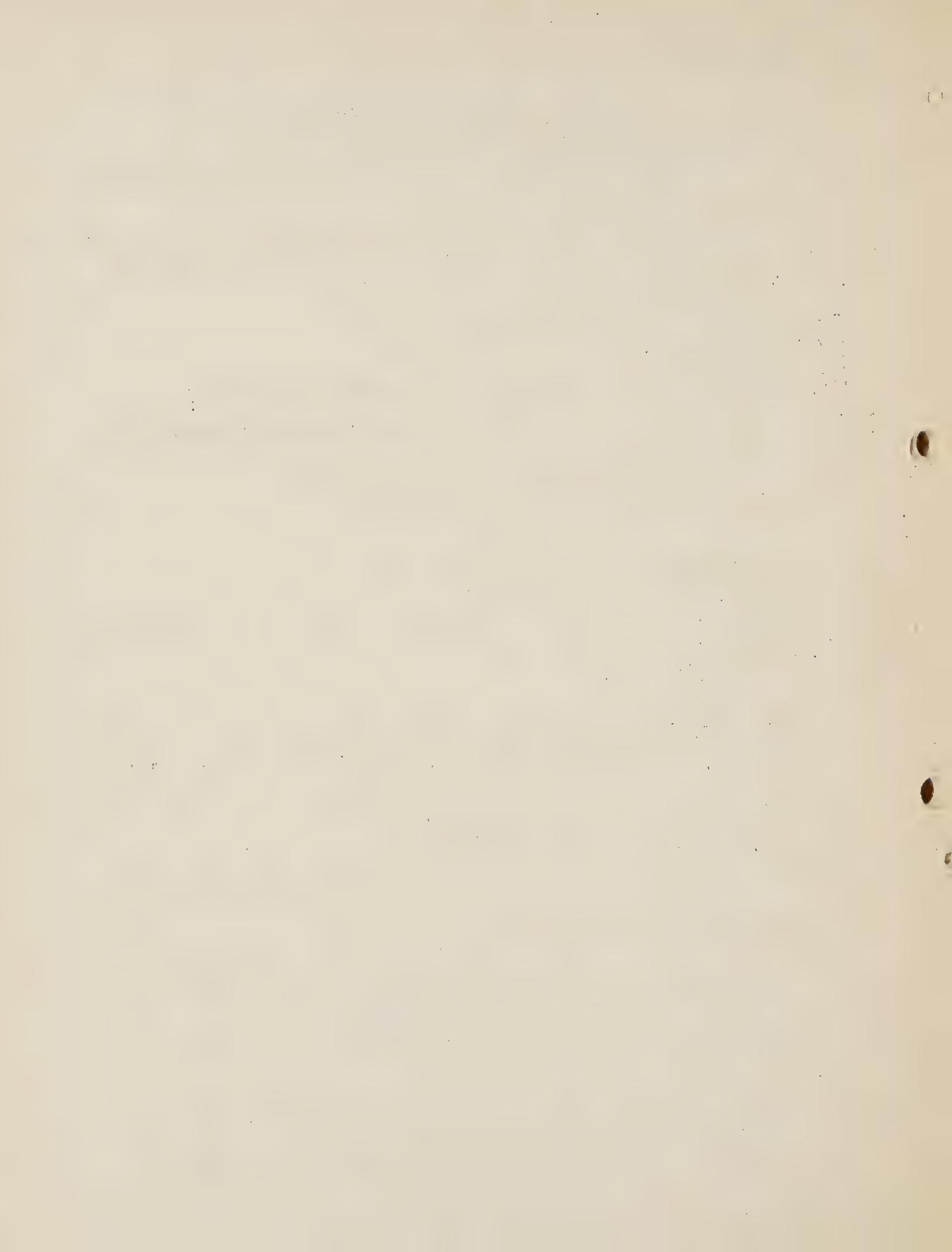
- Assignment: - Laboratory staff.
- A - Superficial observations concerning death of larvae in the field from disease.

X - EXPERIMENTAL METHODS AND TECHNIQUE.

- Assignment: - Mr Barber and assistants.
- Object: - Investigation and development of methods, cages and special apparatus for rearing of material and carrying on special investigations.
- A - Cages for eggs, larvae, pupae and adults.
- B - Incubators.
- C - Laboratory cages containing growing food plant and arranged in such a manner that development of insect may be observed without frequent change or radical disturbance of food plant.
- D - Laboratory cages designed to contain portions of plant upon, or in, which the insect may develop with only infrequent disturbance of food plant.
- E - Large field cages designed to contain growing plants, which can develop in a normal manner, and in which one or more generations of P. nubilalis may be reared without disturbance and retain their vitality. These cages must retain all stages of P. nubilalis liberated therein and exclude all stages of the insect from without.

XI - TAXONOMY

- Assignment: - Mr. Anderson.
- A - Preparation and preservation of adult material.
 - 1 - Reared. 2 - Collected.



- B - Preservation of larval material.
- 1 - Larvae - known, reared or collected in bulk.
- 2 - " reared in individual cages, molts observed and instar known
- 3 - Larvae sent in by field scouts.
- C - Arrangement and care of collection.
- D - Preparation of material for exhibition or study.

XIII - STATISTICS.

Assignment: - Laboratory staff.

- A - Crop losses.

1 - Corn.

a - Sweet. b - Field (flint or dent)

c - Pop. d - Fodder.

- (1) - Losses due to unmarketable product (ears, grain etc)
- (2) - " " " restriction of market area (quarantine)
- (3) - " " " reduced price through reduction in quality.
- (4) - Losses due to control measures.

(a) - Cleaning up. (b) - Spraying etc.

(5) - Losses due to reduced acreage because of presence of insect.

2 - Celery, beans, beets, rhubarb etc.

" a - Same as 1-a (1) to (5).

3 - Chrysanthemums, asters, gladiolus etc.

a - Same as 1-a-(1) to (5)

B - Segregate small block of corn plants at Exp. Plot and endeavor to keep free of infestation throughout the season by hand picking egg clusters and larvae.

1 - Sweet corn growing in middle of susceptible variety.

2 - Field corn " " " " "

Object: - To secure a comparison between number and size of ears and "nubbins" from infested and non-infested plants growing under same conditions.

C - Corn acreages and value of crops.

D - Data regarding comparison of plant development in the Spring with special reference to connecting plant phenomena with time of planting.

E - Weather reports.

F - Maps.

XIII - PLAN OF EXPERIMENTAL PLOTS:

Assignment:- Messrs Hodgson, Grigg, Greeno, and assistants.

A - Grove St. Plot - West Medford, Mass.

1 - Field corn (Plots of 12 rows, each 70 ft. long)

a - Dent varieties (one plot each)

(1) - Leaming (2) - Brewers Yellow.

(3) - White Cap Yellow.

b - Flint varieties.

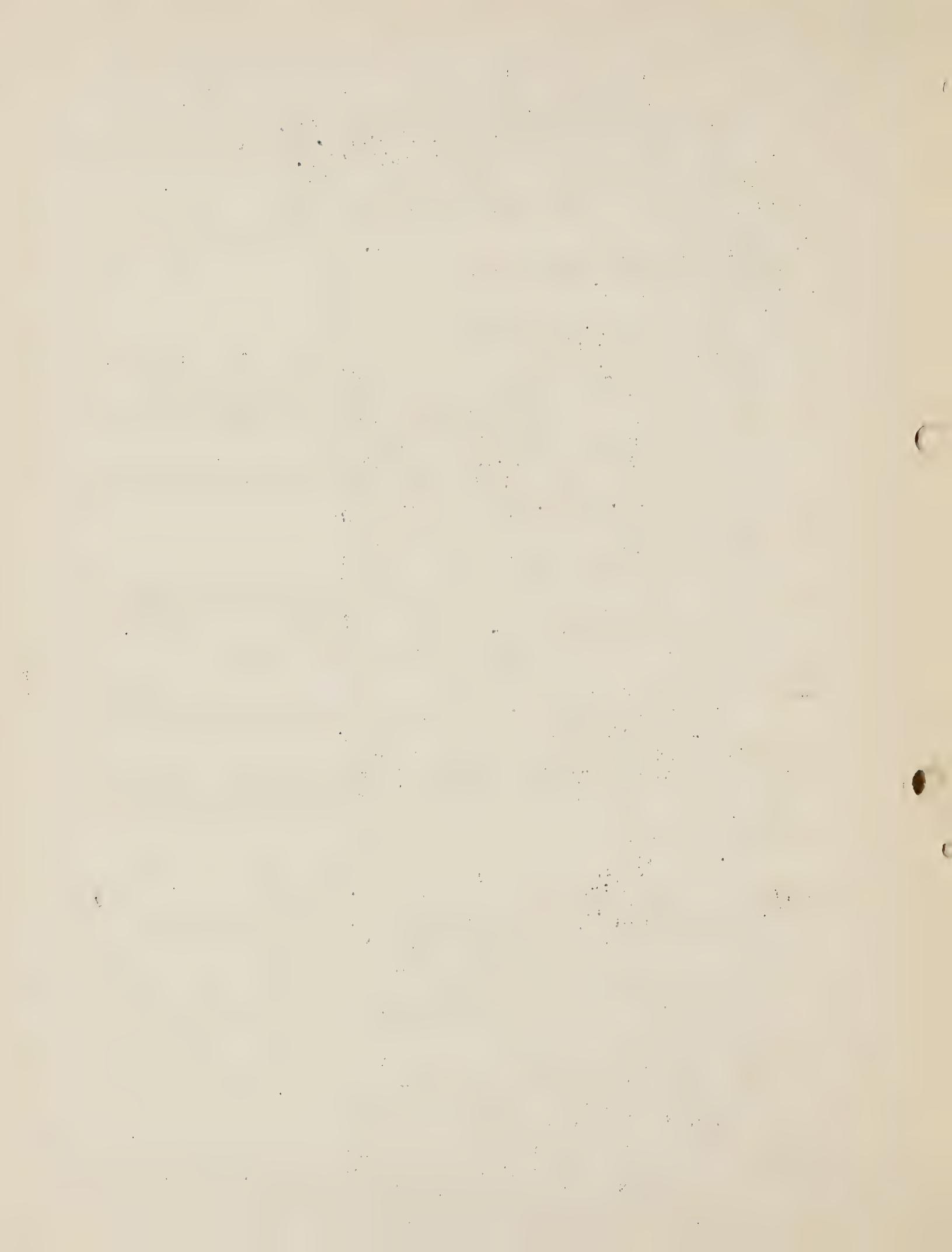
(1) - Sanford (one plot)

(2) - Longfellow (two plots)

(a) - One plot cleanly cultivated.

(b) - " " " not " "

Object:- To determine degree of infestation in these varieties of field corn which mature in eastern Mass. and the comparative infestation between Dent and Flint varieties. Also to check results secured in 1918, 1919 and 1920.



Also to ascertain (b-(a) and b-(b)...) the comparative infestations between cleanly cultivated corn and corn growing among infested weeds, under identical soil conditions and exposed to same degree of infestation. Susceptible field woods may be planted between the rows of b- (b).

2 - Sweet corn (Plots of 8 rows, each 70 ft. long)

a - Early season varieties.

(1) - Quincy Market (one plot May 1st)

(2) - Early Crosby (one plot planted on each of the following dates
May 10th, 20th, 30th)

b - Mid-season variety.

(1) - Golden Bantam (same as 2-a-(2) ...)

c - Late season variety.

(1) - Country Gentleman (one plot planted May 25th, one plot
June 10th)

Object: - To obtain data on relation between date of planting and infestation. Also to check results on variety tests and date of planting secured from 1918 to 1920.

d - Laboratory Plot. Planted at intervals of 10 days from May 1st to provide corn plants for laboratory use.

3 - Non-Saccharine Sorghums (Plots 20' X 23')

(a) - Johnson Grass (b) - Foterita. (c) - Hegari.

(d) - Milo maize. (e) - Sudan grass. (f) - Pink Kaffir.

(g) - Broom corn.

Object: - To determine susceptibility of these crops to infestation with special reference to their probable status as a host if P. nubilalis should become established in regions where these crops are commonly grown. This is a continuation of work began during 1920.

4 - Saccharine Sorghums.

(a) - Sugar cane (Plot 10' X 10').

(b) - Sorghum - "Early Amber Cane" - (Plot 20' X 23')

Object: - Same as A-3. Also to compare comparative susceptibility of non-saccharine and saccharine sorghums.

5 - Cereal and Forage crops.

(a) - Wheat. (b) - Rye. (c) - Barley. (d) - Oats. (Plots 10' X 10')

(e) - Cow peas. (f) - Soy beans. (Plots 20' X 23').

(g) - White Clover. (h) - Peanuts. (Plots 10' X 10').

Object: - To determine susceptibility of these crops to infestation, with special reference to their economic importance as possible carriers of the insect. Also to check results secured from 1918 to 1920.

6 - Vegetable and Field crops.

(a) - Cotton (Plots 20' X 23').

(b) - Celery. (c) - Beans-bush. (d) - Beets. (Plots 10' X 10')

(e) - Sweet Potato. (f) - Flax. (Plots 10' X 10')

Object: - Same as A-5.

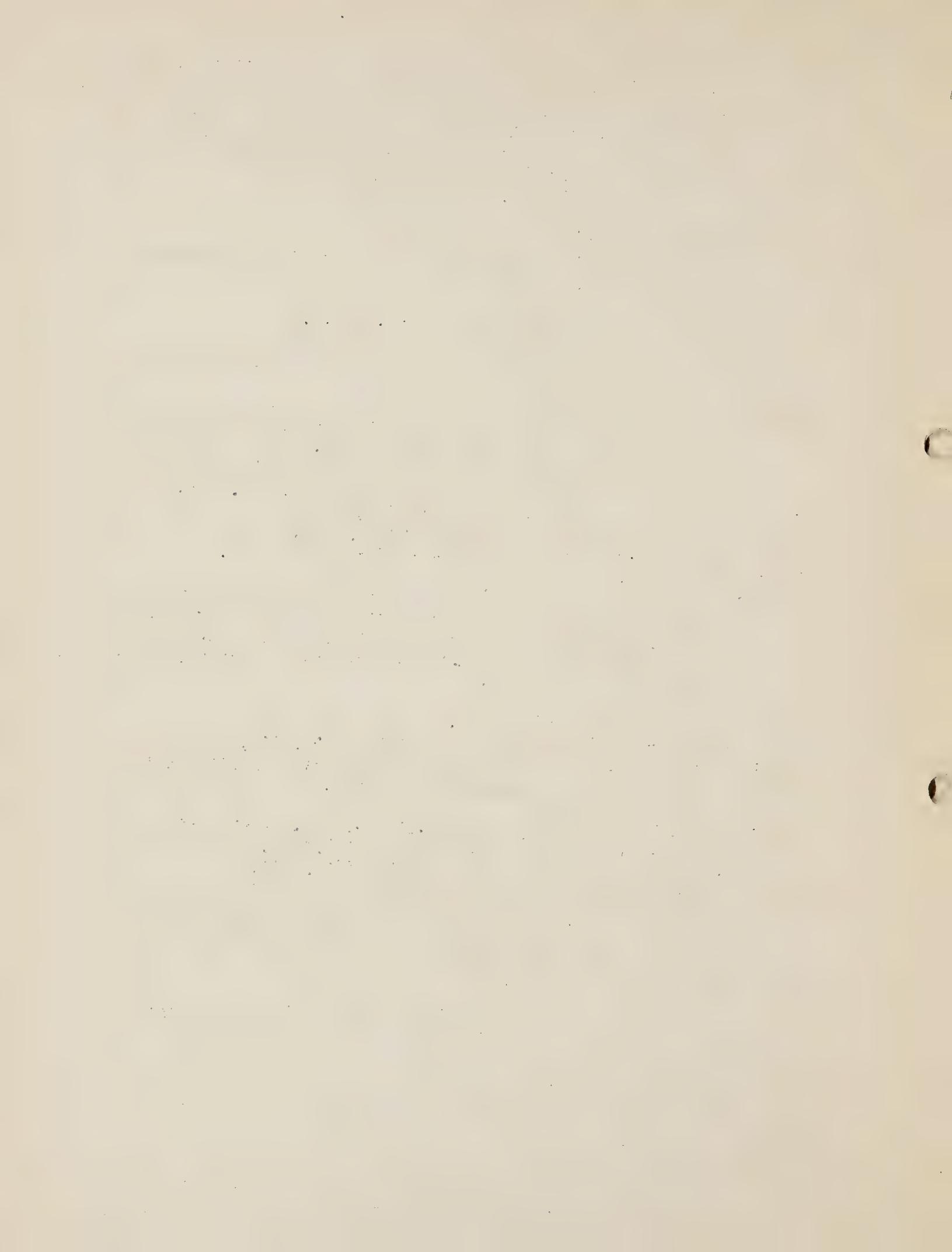
7 - Flowering Plants (Plots 10' X 10')

(a) - Gladiolus. (b) - Cosmos. (c) - Aster. (d) - Zinnia. (e) - Phlox annual.

Object: - Same as A-5 and A-6.

8 - Field cages.

(a) - Small cages containing economic plants to determine their susceptibility as hosts of P. nubilalis eggs or larvae and their status as plants on which the insect may complete part or whole of its life cycle.



(b) - Large cages containing growing plants and designed to rear one or several generations of P. nubilalis to ascertain effect of environment on introduced material (Eastern N. Y.-France etc). Also to ascertain effect of different food plants.

B - Coolidge Plot, Watertown, Mass. (or some other location of about 1/2 acre in the heavily infested and early maturing area of Watertown, Belmont or Cambridge).

1 - Field corn (Plots of 12 rows, each 70 feet long)

(a) - Dent varieties.

(1) - Brewer's Yellow.

(2) - White Cap Yellow.

(3) - Pride of the North Plot 8 rows - 70 ft).

(b) - Flint varieties.

(1) - Longfellow 'yellow)

(2) - Sanford (White)

(3) - Early Canada (Plot 8 rows 70 ft)

Object:- To determine degree of susceptibility of these varieties of field corn when no sweet corn is grown in the vicinity.

Only farm practices of keeping down weeds will be followed.

This is a continuation and check of work started in 1920.

C - (About 1/2 acre to be selected from medium infested and late maturing area in Stonham, Woburn or Melrose)

1 - Field corn (Plots of 8 rows, each 70 ft. long).

(a) - Dent varieties.

(1) - Brewer's Yellow.

(2) - White Cap Yellow.

(b) - Flint varieties.

(1) - Longfellow.

(2) - Sanford.

Object:- Same as A-1 when planted under different conditions of seasonal development, altitude and degree of infestation.

2 - Sweet corn (plots of 8 rows-each 70 ft. long)
Ordinary farm practices of keeping down weeds to be followed.
a - Early season variety.

(1) - Early Crosby (one plot May 10th-one plot May 25th)

b - Mid season variety.

(1) - Black Mexican (one plot May 10th- one plot May 25th)

c - Late season variety.

(1) - Stowell's Evergreen (one plot May 25th - one plot June 10th)

Object:- To determine degree of infestation in these varieties when planted in a medium infested area and with a later maturing season than when these same varieties were planted at Medford and Saugus in 1919 and 1920. Also to correlate date of planting with degree of infestation.

3 - Non-Saccharine Sorghums (Size of plots ?)

(a) - Johnson grass. (b) - Feterita.

(c) - Milo maize. (d) - Broom corn.

Object:- Same as A-3 and C-1.

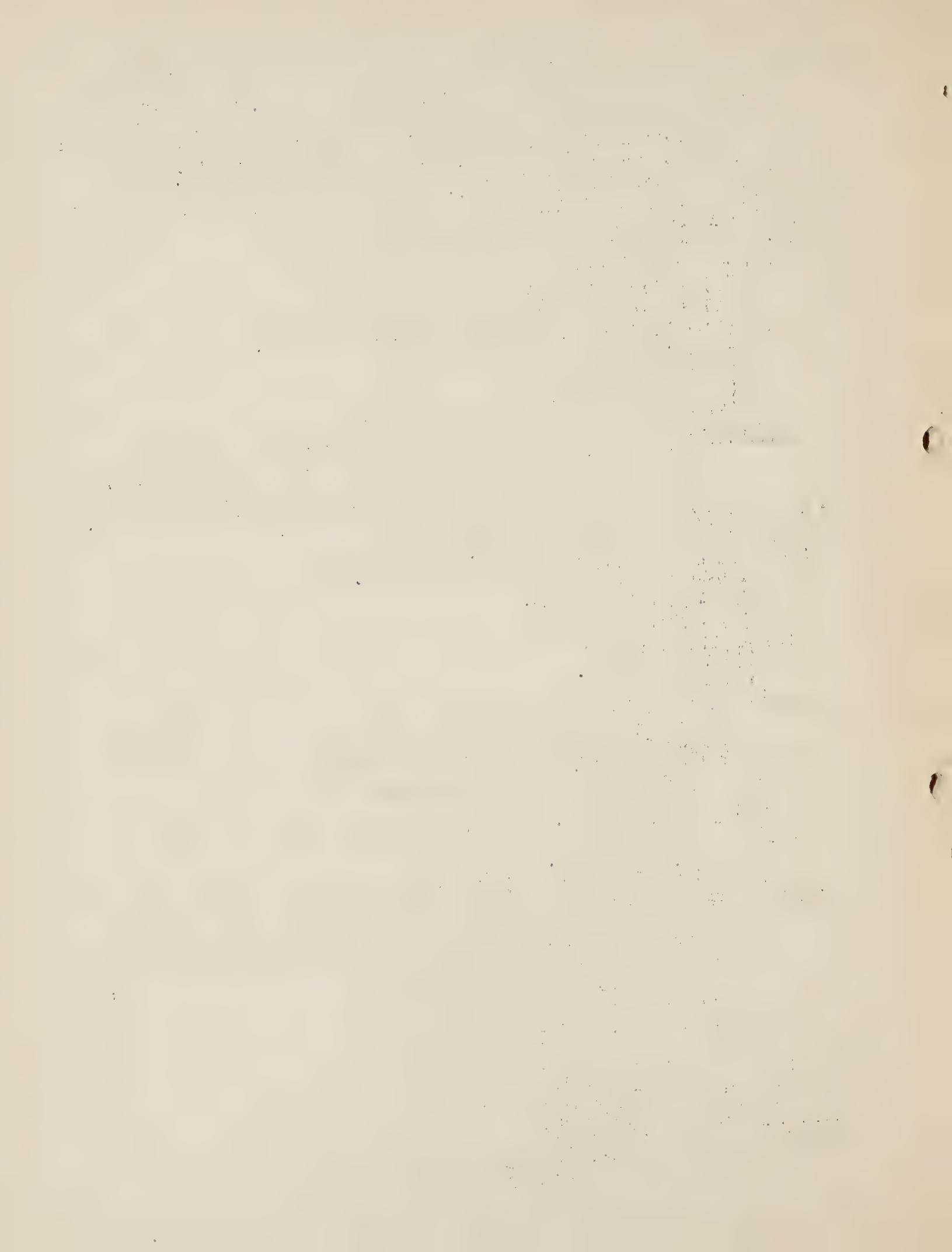
4 - Saccharine Sorghums (Size of plots ?)

(a) - Sorghum - "Early Amber Cane".

Object:- Same as A-4 and C-1.

D - Cooperative Experiment Plots with farmers.

1 - Field Corn- Four fields located within the badly infested area.



- a - Correlate dates of planting and varieties with per cent of infestation in plants and ears. (Cross ref. to "Dispersion and Control")
 - b - Grain injury to ears. (Statistics)
 - c - Proportion of fully developed ears.
Compared to "nubbins" (Statistics)
 - d - Average number of larvae per plant (Statis.)
- 2 - Sweet Corn- Two fields each of early, mid-season, and late sweet corn.
- a to d - Same as D-1.
- Object: - To check results secured in plots A, B, and C when planted under commercial conditions. Also to obtain information on any additional varieties of field and sweet corn not used in experimental plots.

In 1895 I obtained a specimen of *Leptostomum* from a
habitat quite different from those of the other species.

(*L. heterostichum*) was collected at

the head of the Lake of the Woods.

(*L. tenuissimum*) was collected at

the same place in 1896. The two species were collected
from the same locality.

It would be well to add a note on the species of *Leptostomum* which
are not described, as far as collecting from the Great Lakes.
The four species given here will be probably of interest,

